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SOMETHING TO SELL.

That the United States has something to sell abroad is made manifest by the rapid growth of its export trade in all branches of mechanical production. These exports, coming to the support of those in agricultural and mining products, have placed this country at the beginning of the century first on the list of exporting nations. The figures for 1900, in millions of dollars, are: United Kingdom, 1418; Germany, 1050; United States, 1453. The recent gain, moreover, has been quite striking. That for the United Kingdom in the last four years was 20 per cent; for Germany, 23 per cent, and for the United States, 45 per cent. The export trade of France has, unfortunately, been stationary.

There seems little reason to fear that foreign appreciation of our goods will diminish. It might do so if subject to "retaliatory" measures such as have been encountered recently in connection with the import tax on Russian sugar; but there is a marked tendency toward the cultivation of trade on a basis of reciprocity. Beyond such reciprocal trade, capable of pushing the figures far above anything now known, there is, of course, the trade of new regions. The protectorates that the United States and the Powers of Europe are now establishing in one form or another over all other parts of the world has but one meaning in these modern days—more trade, from which all benefit.

METHOD PATENT CLAIMS

An important decision appears in the current *Official Gazette* of the United States Patent Office relating to method claims. The question of method or process claims has been in a very unsatisfactory state, inventors putting such claims in their applications being almost invariably met with the stereotyped objection, "The claims are merely on a function of the machine and are, therefore, not proper methods." The decision in question was on an appeal from a decision of the Commissioner of Patents relating to certain details of an electrical measuring instrument. Two of the claims are on mechanical operations consisting in drawing a section of a metal over a mandrel and subjecting it to pressure until a desired configuration is acquired, and then turning down the lateral edges. The court decided that this is a simple and well-known operation which contained no element of patentable novelty.

The other two claims at issue were paraphrased by the court as follows: "The appellant has discovered that by taking a spool of sheet metal with a coil properly wound around it, and adjusting it in a certain manner on pivot pins and adjusting the needle in a certain manner through the instrumentality of the pivot which supports it, he can accomplish a desired purpose." The Court held that "this process or method, while it may require the use of delicate mechanism for its actual development and manifestation and to effect the desired adjustment, seems to be a mental operation entirely independnt of such mechanism; that the process is first in the logical order of things and the mechanism only a sequence."

In discussing the principles at issue the court stated that a certain decision of the Supreme Court seems to have been understood by some courts, and to some extent by the Patent Office, as restricting the patentability of processes to those which involve chemical or other elemental action. This the Court held to be an erroneous impression, and it added the following from authorities bearing on the point:

"First, that processes involving a chemical or other elemental action, if new and useful, are patentable; second, that a process which amounts to no more than mere invention of the machine is not patentable; third, that a process or method of mechanical nature not absolutely dependent on a machine, although perhaps best illustrated by the mechanism, may, if new and useful, be the subject of a patent, even though it involve no chemical or other elemental action." In the latter case the criterion of the patentability would seem to be, not that the process or method in question is independent of the special mechanism by which it is given practical effect, but that it is clearly conceivable as a mental operation independent of any such mechanism. The view taken by the Court in this case appears to be an eminently sensible one, and the precedent set by the decision is of the highest value to inventors.

HOMES AND AUTOMOBILES.

One of the noteworthy feature of recent development in New York City has been the erection of homes and fine buildings where stables once stood. The change, for example, in such a street as West Forty-fourth, now full of beautiful clubs and hotels, is in reality extraordinary, but it is being duplicated elsewhere. The work which the trolley began in redeeming large areas of the city from horse occupation and rendering them available for human beings is now being carried forward and finished by the automobile. The new electric automobile stables in West Forty-ninth Street, occupying a whole block, have relieved the region of the horse taint and odor and dust, and have made it possible to put up handsome buildings on ground that once was hardly deemed fit for negroes. The same change can be seen working all over the same district, and as soon as the automobile has been brought up to the level of the trolley car in economy and efficiency, that portion of New York will not be recognizable. Further down town, where trucks and wagons are stored, the old insanitary conditions will prevail much longer, it is to be feared. Malodorous horse stables can still be found shoulder to shoulder with artisan homes, breeding and fostering disease in a manner that needs legislation, just as the cow and pig did in old New York.

OHM'S LAW.

There is scarcely any proposition so generally recognized among electricians, and so generally ascribed to one and the same individual, as that law of electric-current strength in continuous-current circuits dependent upon their electromotive force and resistance which bears the name of "Ohm's law." It may surprise electricians, therefore, to learn that in the field of acoustics there is another and totally different Ohm's law; namely, that a complex harmonic musical tone is only recognized by the ear by first analyzing it into its harmonic constituents, and that the sensation is the sum of the sensations of the individual simple component tones. To an acoustician, therefore, who had no knowledge whatever of electrical matters, Ohm's law would stand for an entirely different conception to that recognized in the electrical world. It is a curious fact that in the electric transmission of waves, either in wireless telegraphy through the ether, or in the transmission of electric energy to long distances over wires, the attempt is made to restrict the electric pulses to simple harmonic tones. In music, however, simple tones are comparatively uninteresting, and complex harmonic tones are greatly preferred for their richness. But in electric telephony in order to transmit the vocal tones with any approach to faithfulness, the transmitted waves have to be of many different frequencies, and harmonics have to be cultivated and fostered.

TRANSFORMER INCIDENTS.

An article by Mr. T. W. Varley in last week's issue called attention to some of the more unusual and puzzling phenomena occasionally presented by alternating-current transformers. Particular attention was called to the rush of current which will sometimes enter a transformer primary on closing the primary circuit, even when the secondary circuit is broken. As explained in the article, this is due to the interruption of the primary circuit at an instant when the current wave was close to the peak when the current was last shut off. This is a phenomenon that has excited considerable attention in England, and where a paper was read upon inductive current rushes before the British Institution of Electrical Engineers.

On a reduced scale the effect may be noticed in any transformer, even to the smallest size. On suddenly making or breaking the primary current a number of times in succession, there are always some breaks occurring at the top of a current wave and some near the zero. When a make happens to succeed a break at full wave in the same direction, the entering current strength will be greatest. The current rush in such cases is usually insignificant in transformers operated on circuits employing a relatively high frequency, but may be much more marked on circuits of relatively low frequency. This is for the reason that with high frequencies, transformers are not pressed in magnetization, because the hysteresis loss with so many cycles would amount to a considerable waste of energy. The maximum cyclic magnetic intensity is, therefore, kept comparatively low, and, if necessary, the magnetic intensity might be nearly trebled in value for a special effort, without requiring any violent magnetizing current. On low-frequency circuits, however, the magnetic intensity is economically increased, and then the magnetization reserve up to the maximum that the iron will carry may not be sufficient to carry the transformer over the first wave of e. m. f. without an enormous wave of magnetizing current. If the same reserve of magnetic intensity range were kept in low frequency, as in high-frequency transformers, the former would be heavier than they actually are, and additionally expensive.

If it were not for the extra loss in iron by hysteresis and eddy currents, it would be manifestly advantageous to increase the frequency for the supply of transformers, and, even allowing for these losses, if the question of frequency depended merely upon the transformers, it would still be more economical to adopt a reasonably high frequency. The opposite proposition is obviously true, that where a very low frequency is used, the iron cores must be greatly increased in area, for the same number of turns, in order to carry the necessary magnetic flux. As a broad proposition, high-speed motors and high-frequency transformers must be lighter than low-speed motors and low-frequency transformers of the same power; but, in practice, low-speed motors are often greatly to be preferred to high-speed motors, even at extra cost, and low frequencies are rendered imperative for commercial service notwithstanding the requirements of transformers.

THE TRANSFORMER'S POSITION IN A POWER TRANSMISSION SYSTEM.

In all long-distance transmission systems we have one generator plant, one motor set, and one transmission line, in the broadest sense of those terms. But we have two transformer sets, one stepping up and the other stepping down. Electrically speaking, and ignoring for the moment the change of pressure effected by the transformers, the latter machines are simply equivalent to the insertion in the main circuit of a definite amount of resistance accompanied by a definite amount of reactance. In other words, although there is in long-distance transmission a marked advantage by the use of transformers in the reduction of the amount of

aluminum used in the line, yet the advantage has to be paid for at the expense of some extra resistance, and several times more reactance virtually inserted into the main circuit.

In the case of overloads, generators always possess some reserve and often a considerable reserve of capacity for temporary extra service. Most generators will stand 25 per cent overload for an hour or two, and some are guaranteed to stand 50 per cent overload for a shorter interval. The motors also will usually stand overload to a similar extent. In both cases the limiting load is practically imposed by the temperature elevation of the machine, and the normal temperature elevation of 40 degs. C. is not so serious but that it may be temporarily exceeded without danger, especially in cold climates. But in the case of the transformer, the margin of overloads is usually much more restricted, since they are compact machines, without internal moving parts to fan them and change their surrounding air. They have to depend in large sizes upon external cooling for the best performances of their work, as otherwise they have to be made of unduly large size. And even when cooled by external means, their normal range of overload without considerable heating is more sharply defined than in the generator or motor. It is for this reason, as well as for improved regulation, that in well designed transmission plants it is usual to employ ample transformer capacity, or an excess above the normal full-load requirement, whenever temporary overloads are likely to occur. It is, therefore, a great blessing when the pressure at which the generator and motor can be constructed is sufficiently high to call for only a moderate amount of conductor to connect them over the intervening distance. Pressures of from 6 to 10 kilovolts are now capable of being safely employed in the generator, and step-up transformers are only absolutely needed when the line pressure has to exceed this.

THE ELECTROLYTIC VARIETY OF BLACKMAIL.

It unfortunately often happens that scientific facts are turned to queer purposes. Garbled quotations from reputable medical papers are made the working capital of quacks or the favorite weapons of wild-eyed fanatics. A post-prandial *jeu d'esprit* on the part of a reputable investigator may appear next morning with "scare" headlines to help along the thievery of a stock-jobbing swindler, or an innocent research may be used to further the exploitation of an alleged invention. The fakir is splendidly resourceful in little matters like these, and often uses data of this kind with consummate skill. A quarter of a century ago, before the electrical renaissance was fairly under way, the lightning rod agent gained full sway over rural communities. He was often heralded by an advance agent with a peculiarly weird and horrible collection of tales of fatalities from the "deadly fluid," which he judiciously planted among the local newspapers. Presently along came the glib tongued agent with science fairly oozing from his finger tips, and a full collection of wonderfully gilded rods of strange cross-sections which he dispensed at a dollar per foot, more or less.

The lightning-rod fraud has now for the most part gone out of business, but his art has not been forgotten, and his methods still flourish. We are moved to recall him to memory by such bills as that introduced into the Indiana Legislature recently for the abolition of the single-trolley system on account of the destructive effects of electrolysis. Now we have no grudge against the double trolley, we do not wish to decry the storage battery, and we greet with earnest approbation any and every improvement of the track circuit; but we fancy the legislative hearings will be of a character to provoke smiles. It is well known that legislatures have been used to club electric railways in various ways and from a variety of mixed motives, but there are few more flagrant instances than this. When a few years since attention was called to the effect of grounded circuits in producing electrolytic effects in underground pipes, the subject was taken up as a practical scientific problem, and all the parties concerned co-operated in a friendly spirit. There was no denying the fact and little hesitation in applying vigorous remedies. But no sooner were the facts fairly established than they became the subject of malevolent and disingenuous misinterpretation. Logic was thrown to the winds, and the simple and truthful statement that currents in the earth can and sometimes do attack pipes, was expanded into loud asseverations that every single trolley road was responsible for an untold amount of destruction, and that the gas and water systems of every city were at the mercy of the evil-minded interloper. Every gas company that owned a set of rusted-out and worthless mains, never sound and yearly growing more useless, girded itself for the fray and laid it all to the electric railway. In this noble cause they were joined by disinterested water commissioners who in consideration of the customary rake-off had accepted mains that could not have been sold for old iron elsewhere. Again science was involved, for it was soon made evident that electrolytic corrosion as such could not always be told from every-day rust, and the railway had to take the blame.

Now, there is no doubt that electrolysis may be a serious matter, and in some instances has done a deal of mischief. On the other hand, it is incontestably true that in a very large number of places there is practically no damage from electrolysis, and in still other cases that the damage is trivial and local. The facts can easily be made evident by a careful and thorough investigation of the conditions by some competent engineer. And when the damage, if any, is located and its extent is determined, proper steps can be taken to remedy it and to prevent its recurrence. Such matters had better be settled out of court, and if both parties are acting in good faith this can generally be accomplished. But such drastic measures as that to which we have referred are obviously not in good faith, nor are they impelled by disinterested motives. In fact, they are open to the implication of being next of kin to blackmail. We never hear of such an attack without instinctively casting about for the nigger in the woodpile, and with a very good prospect of locating him.

This raiding of quasi-public corporations is a growing evil. Electric railways, electric light companies and telephone companies are favorite victims, so that the practice presses the electrical arts very closely. In times past and present legislative bodies have not been always pure, nor lobbies philanthropic. But to tell the truth the companies themselves have sometimes developed cannibalistic tendencies that have not exactly tended to public sanctification. When two such fall out they are not always scrupulous to set a good example as to ways and means. The bitter and prolonged fight against the introduction of high-tension alternating currents waged by the advocates of low tension did more to guide the guileless legislator and the high-minded alderman into the devious ways that lead unto corruption than can be undone by a quarter century of upright living. There have been other struggles little less disastrous as campaigns of education. With the present tendencies of the times such internecine strife can be productive only of evil results. The public that is the final court of appeal in such cases is, mayhap, fickle and short of sight, but it can tell its friends from its enemies, and in the long run will see fair play. The enterprise that deals always squarely with its public will find that public standing with it in time of adversity, and will settle upon a firm foundation when fake enterprises and stock-watering combinations are tumbling like card houses. But it behooves the electrical industries to oppose a united front to such attacks as that to which we have referred, and never by internal dissensions or hope of temporary gain to give the common enemy a chance to break their square.

Bell Telephone Growth in New York.

It is understood that in order to cope with the growth of the business, the New York Telephone Company has begun to install a 9400-subscriber central energy lamp signal switchboard at its Cortlandt Street exchange. The board may be ready about July. It will be one of the largest in the world, and marks the new departure in Bell telephone practice, a board of 6000 subscribers having been the general limit hitherto in America, as pointed out by Mr. Kempster B. Miller in his telephone lecture recently before the New York Electrical Society.

In regard to this rapid growth of the telephone in the Boroughs of Manhattan and the Bronx, one of the executive staff of the company makes the assertion that within five years and probably within three years the total number of telephones in the old City of New York will aggregate 100,000. "In the last year of the old century," he said, "14,210 new stations were established in the district of Manhattan and the Bronx, which is practically the old City of New York. The first exchange was established in 1879, and two years later there was a system of about 2000 stations. We had rising 10,000 stations on Jan. 1, 1895, making a gain of about 7400 stations, or an average increase of 530 stations a year. Up to this time there had been a flat charge for the use of the telephone. Then came the change to the rate system, and with it the steady increase that has surprised even those most familiar with the use and workings of the exchange. From that time, Jan. 1, 1895, to the end of the last century there was an increase in the number of stations of 41,175, an average yearly increase of 6862 stations. That increase was at a rapidly accelerating rate, however, for in 1899 the growth was 10,500, and for 1900 14 200, the latter a growth of more than 35 per cent as between the two years. The exchange system has been in general use for 20 years, say, and yet there are scarcely a dozen cities in the whole world that have as many stations in their entire system as there was increase in one year in the single exchange in this city. Of course, it is impossible to tell what the percentage of increase of stations will be in the future, but the telephone has become so indispensable that I feel safe in saying that three will be fully 100,000 stations here in five years, probably in less. If the average of increase from the beginning to 1895 had only been maintained there would to-day be but 13,000 stations in New York, less than the actual gain of last year. At that old rate of increase it would have taken until 1975 to have reached the total number of stations now actually in existence. It would also have taken 170 years to reach a total of 100,000 stations, which we now look upon as a certainty by the middle of the year 1904, and possibly before that time. The telephone comes now about as near to being a universal necessity in the life of the city as gas or water."

Trade with Russia.

Advices from Washington state that exports of manufactures from the United States to Russia do not amount to $30,000,000 per year, as has been asserted, nor have they ever reached one-fourth that sum. This assertion is sustained by the official figures of both the United States and Russia. According to the figures of the United States Bureau of Statistics, exports of manufactures to Russia range from three to four million dollars per annum, and according to the Russian official statistics, they have averaged a little over $4,000,000 a year since 1895, the earliest date at which the detailed figures of Russian imports are obtainable.

The Russian statement of total imports of goods of all classes originating in the United States have never, save in two exceptional years, shown as much as $30,000,000, and have averaged since 1895 less than $25,000,000 per annum, and of this sum more than three-quarters represents raw cotton, which is not affected by the recent order of the Russian Government. Much of the American cotton imported into Russia is bought in the markets of Europe and thus, while represented in the Russian importations as of American origin, does not show in the export statements from the United States, because it is sent from this country direct to the great cotton markets of Europe, Liverpool and Bremen, and thence is distributed to Russia and other interior States of Europe.

The reports of the United States Government only show total exports to Russia of about $10,000,000 per annum, while those of the Russian Government show imports of American products averaging about $25,000,000 per annum; but an analysis of the two statements shows that the discrepancy is chiefly in cotton, which discrepancy is accounted for as above indicated.

International Conference on Patents and Trade Marks.

Secretary Hay has asked for an appropriation of $10,000 for an international conference to be held in Washington this year for the protection of patents, trade-marks, etc., under the terms of the international convention concluded in Paris in 1883, to which the United States is a party. This provides that the convention shall be submitted to periodical revisions for the purpose of introducing improvements, and that conferences shall take place successively in one of the contracting States. A conference was held at Brussels, Belgium, in December last, which adjourned to meet at Washington on a date to be arranged by the Government of the United States. The work includes the gathering and distribution of the propositions for amendment, all of which must be completed at least six months before the meeting. In view of the fact that the members of the Union are widely separated, it requires considerable time to make the necessary arrangements. Secretary Hay says that in order that the duty of the United States may be fulfilled in a timely and suitable manner, it is necessary that early provision should be made by Congress for vesting in the Secretary of State the appointment of persons as delegates to the conference, and for an appropriation.

International Increases in Export Trade.

The United States now stands at the head of the world's exporting nations. The complete figures for the calendar year 1900, when compared with those of other nations, show that our exports of domestic products are greater than those of any other country. The ottal exports of domestic merchandise from the United States in the calendar year 1900 were $1,453,013,659, those from the United Kingdom, which has heretofore led in the race for this distinction, were $1,418,348,000, and those from Germany $1,050,611,000. Additional interest is given to the rank which the United States now holds as an exporting nation by the fact that a quarter of a century ago she stood fourth. In 1875 the domestic exports of the United States were $497,263,737, those of Germany $607,096,000, those of France $747,489,000, and those of the United Kingdom $1,087,497,000. To-day the United States stands at the head of the list, the United Kingdom second, Germany third and France fourth, with the figures as follows: United States, $1,453,013,659; United Kingdom, $1,418,348,000; Germany, $1,050,611,000; France, $787,060,000. All of these figures, it should be remembered, relate to the exports of domestic products. Thus in the quarter century the United States has increased her exports from $497,263,737 to $1,453,013,659, or 192 per cent; Germany from $607,096,000 to $1,050,611,000, or 73 per cent; the United Kingdom from $1,087,497,000 to $1,418,348,000, or 34 per cent, and France from $747,489,000 to $787,060,000, or 5 per cent.

Hardware Dealers and Electrical Goods.

At the recent meeting of the retail hardware dealers of Iowa, one of the papers read contained the following remarks: In some parts of the State rural telephones are quite the fashion, and soon must farmers will have telephones and free delivery mail boxes. The hardware dealer should post up on these subjects and not only be able to furnish all the supplies in the way of wire, batteries, telephones, insulators, brackets, etc., but he should interest his farmer customers and promote new lines. The profits are small, but it requires no extra capital, as the sales are for cash, and it brings people into the store.

Electrical door bells and batteries are staple goods and are regularly called for, but there is a long list of other electrical appliances that might be profitably handled, such as burglar alarms, automatic fire alarms, annunciators, motors, fans, house and factory telephones, call bells, electric light wiring, etc. It is an interesting subject, and the ingenious dealer who fits up an attractive sample board, connected with a battery, will find profitable returns from this side line.

The much-abused lightning rod should not be overlooked by the dealer who is ambitious to handle goods that will afford him more profit than the sale of saws at about cost. Most people believe that a well-made lightning rod, properly put up, will afford some protection to the building thus equipped. The sale of lightning rods will depend entirely on the ability of the salesman to work up sales. Few, if any, will come into a store and call for them, even though they have always considered them a good thing. It requires less ability to put up lightning rods than to put up eave trough and conductor. Fifty dollars will supply sufficient stock for a start in this line.

Electrical Transmission from Coal Mines.

BY FRED WILSON HART.

ABOUT three years ago the Cochiti Gold Mining Company erected a large cyanide mill at its Albemarle mine near Bland, New Mexico. A large Corliss engine was installed for driving the crushers, rolls, screens, etc., cord wood being used for fuel. Owing to the phenomenal development of the mine it was deemed advisable about two years ago to increase the capacity of the mill. The question of fuel was one of the points to be considered, as wood cost from four to five dollars per cord, and owing to the extremely rough character of the country surrounding the mine there was a limit to the amount to be had at this price, a large percentage having to be packed in on the backs of burros. It was impracticable to use coal, as it would have to be hauled by wagon from the nearest railroad station, over a rough, mountainous country, a distance of 25 miles.

A careful examination was made of the streams within a radius of 40 or 50 miles and it was found that there was no available water power that could be economically applied, the minimum flow being so small as to necessitate the construction of large reservoirs. An examination was therefore made of the large coal deposits belonging to the Santa Fe Railroad at Madrid, New Mexico, and as bituminous coal of an excellent quality and almost unlimited quantity could be had at a nominal price, it was decided to install a modern steam plant at Madrid and transmit power electrically to the Cochiti Company's property, a distance of 32 miles. The idea of installing a plant at Madrid was decided upon definitely by the Cochiti directors in June, 1899, but owing to the crowded conditions of all factories manufacturing apparatus required for this work, active construction was not commenced until October of the same year, and current was turned on the line on April 13, 1900.

While the transmission of power over long distances is now nothing unusual where the source from which the power is derived is water, very few attempts have been made to transmit electric power from plants located at coal mines, and it may therefore be of interest to note the following comparisons:

The total cost of supplying power with the old steam plant, using cord wood as fuel, hoisting and milling 200 tons per 24 hours, was $218 per day. The cost of doing the work with electric power generated at Madrid and transmitted 32 miles is $52.75 per day for hoisting and treating 300 tons, which is a half more ore than handled by the old steam plant. (These figures do not include interest and depreciation on either equipment.) As the load was of an intermittent character, consisting of an air compressor, hoist, pumps, etc., which were not fitted for attaching indicators, no reliable data regarding the amount of power used by the old steam equipment could be had, therefore a comparative cost per horse-power cannot be given. There are probably few localities presenting conditions so advantageous for utilizing power generated at coal mines as those under which the Cochiti plant is operated. The saving made demonstrates that under favorable conditions power generated at coal mines can be transmitted long distances and compete with steam power.

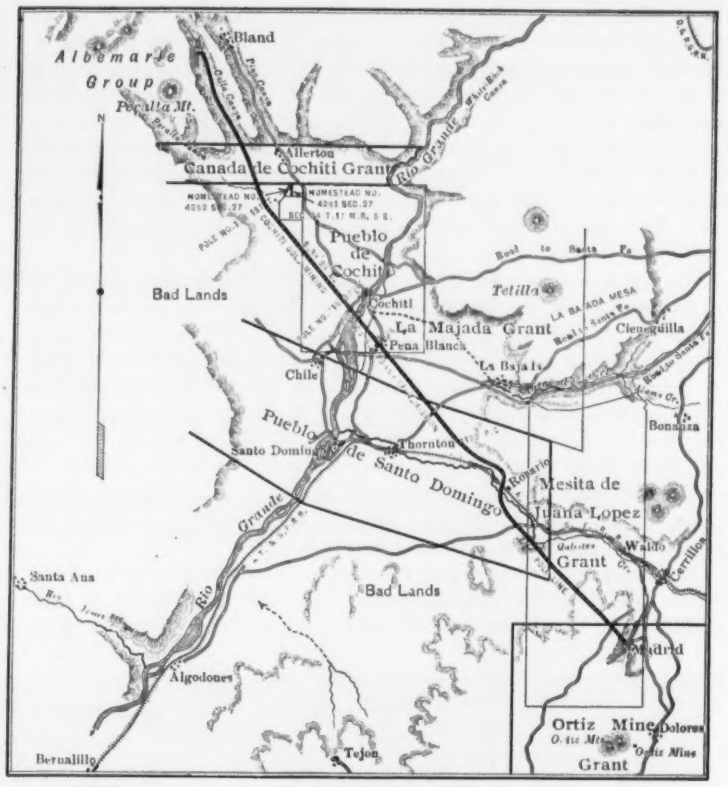


FIG. 2.—MAP OF TRANSMISSION LINE.

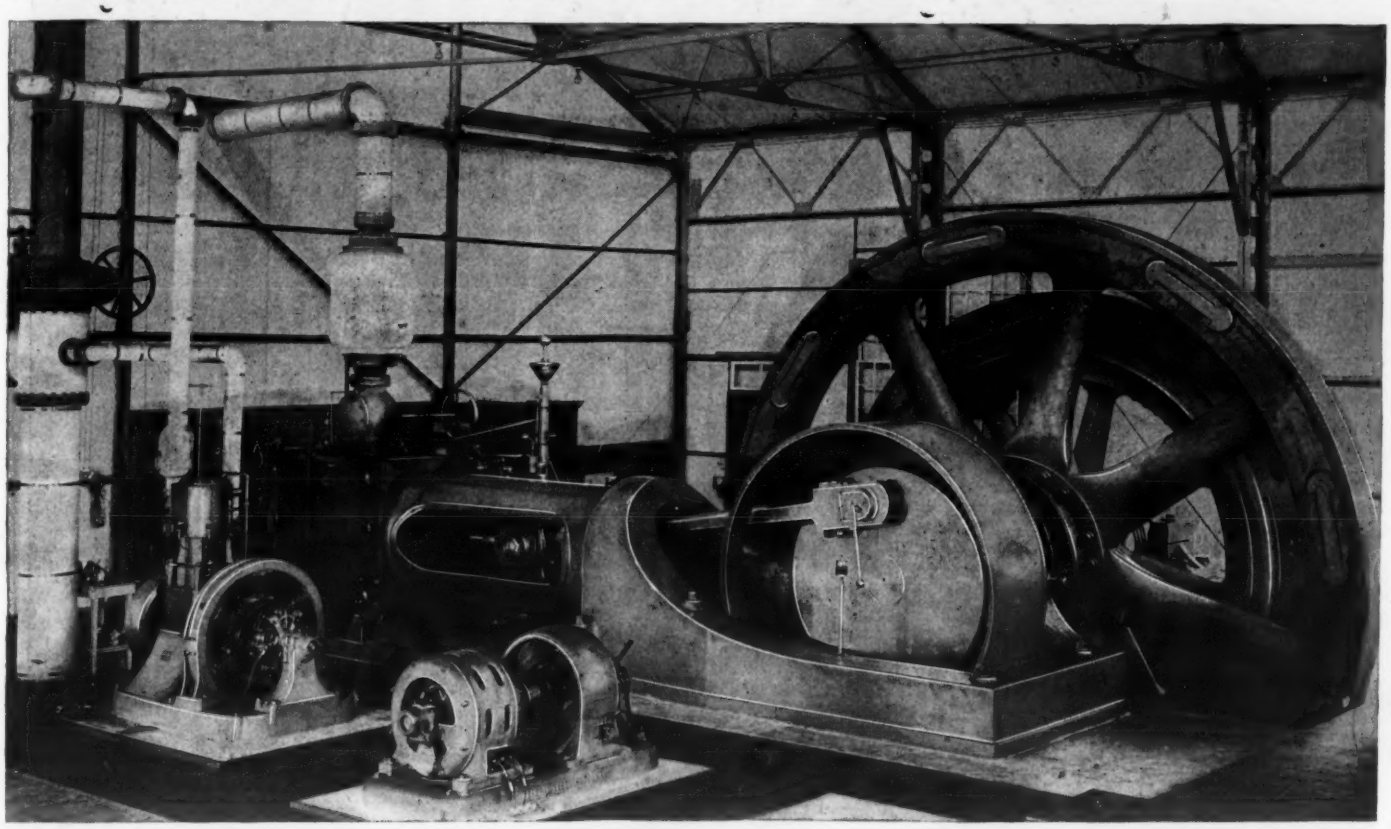


FIG. 1.—ENGINE ROOM.

While the conditions concerning the comparative cost of fuel were

favorable for the Cochiti plant, its isolated location, the rough, mountainous country across which the pole line had to be constructed, the lack of feed water of any kind at the coal mines, made the cost of construction much greater than would be required for the average plant. The feed water supply was the one point on which the success of a plant installed at Madrid seemed to depend. The coal company operating the mines was obliged at times to ship water in tank cars a distance of 40 miles. This, of course, was not practicable for a power plant, and it was necessary to procure a supply within pumping distance or haul coal to where water could be had. Owing to the excessive freight demanded by the railroad company, the former plan was adopted and a 4-in. pipe line was built from the power house to the Galisteo River. a distance of 14,000 ft.

The Galisteo is a typical Mexican arroya in which, for 11 months of the year, there is no sign of water on the surface, but which has a heavy underflow at a depth of 3 or 4 ft. A crib was built under the quicksand in which the water was collected, and on a test lasting 48 hours demonstrated that a supply of 250,000 gallons per day could be depended upon. As the water was known to be of a very bad quality, an artesian well was drilled at the same time the crib was being built, with a view of getting water of a better quality. It was not deemed advisable to locate this well at the power house owing to geological conditions, and it was therefore placed at the point where the crib was located on the Galisteo River.

One pump house contains an artesian well pump and two motor-driven Gould triplex force pumps. The force pumps can be connected either to the artesian well supply or to that of the crib. Fortunately, the artesian well has been able to supply all demands up to the present time. A motor-driven deep well pump with the pump barrel 200 ft. below the surface delivers water to a small receiving tank from which the force pumps deliver it through the 4-in. pipe line to two steel storage tanks having a capacity of 100,000 gallons. The elevation of these tanks is 410 ft. above the Galisteo River, and high enough above the power house to allow the water to flow by gravity into the exhaust feed water heater, a butterfly valve automatically regulating the supply to this heater. The water is pumped from the heater into a live steam purifier which is under boiler pressure. The purifier is located above the boilers and water is fed to them by gravity. The heater and purifier are of the type manufactured by the Hoppes Manufacturing Company, the steam coming in direct contact with the water, which is held in a series of pans.

The analysis of the artesian water gives an idea of the conditions under which boilers in the Southwest are working, and it may be of interest to note that this is considered good water in that locality.

Analysis of water from Cochiti artesian well.

	Grs. in U. S. Gals.
Organic	5.715
Sulphate of lime	27.502
Carbonate of lime	2.378
Carbonate of magnesium	8.204
Chloride of sodium	7.382
Sulphate of sodium	45.737
	96.918
Incrustating solids	38.084

No trouble has been experienced with the boilers, which are carefully cleaned and inspected every eight days.

The power house equipment, when complete, will consist of two General Electric three-phase, revolving-field type, 605-volt, 60-cycle generators, direct-connected to 32 by 48 ft. Allis-Corliss engines, running at 90 r. p. m., having flywheels 20 ft. in diameter and weighing 70,000 lbs. Only one of these units is installed at present. The commercial efficiencies of the generators, not including friction losses, are 93 per cent at full load, non-inductive; 92 per cent at three-quarters load, non-inductive, and 89 per cent at half load, non-inductive.

There are two 125-volt exciters, one being direct connected to a

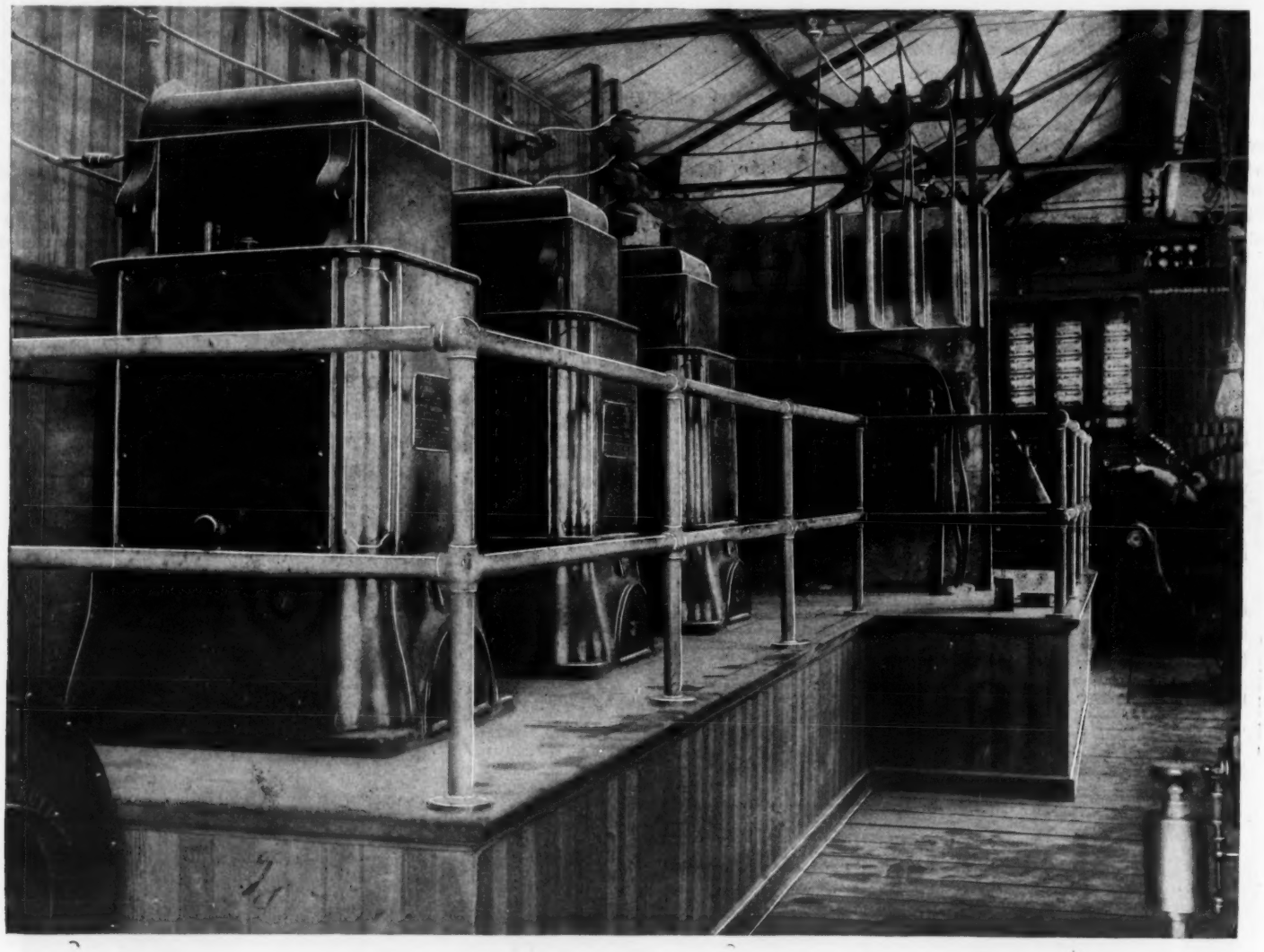


FIG. 3.—INTERIOR OF RECEIVING STATION.

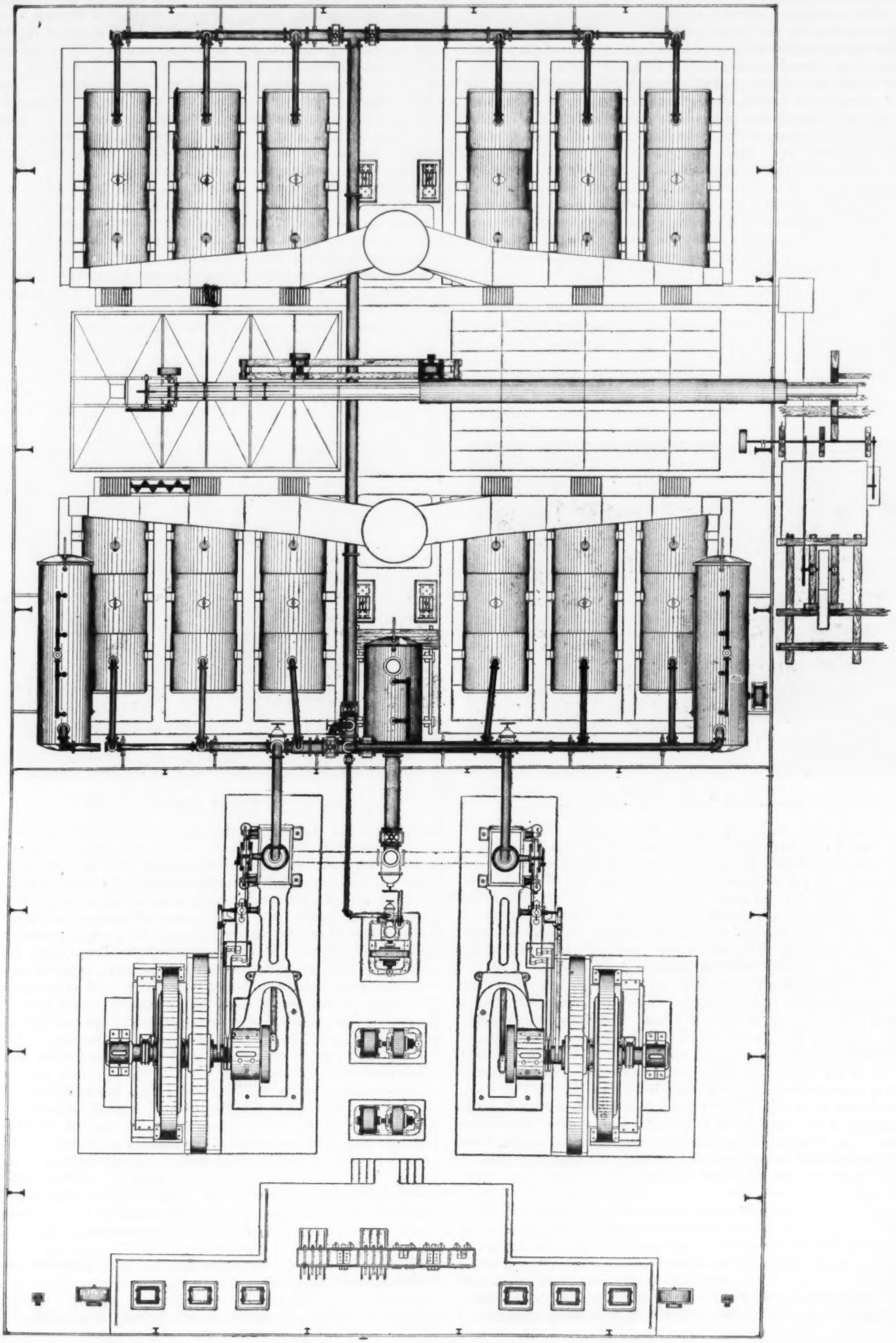


FIG. 4.—PLAN OF COCHITI POWER HOUSE.

vertical marine-type engine; the other is a motor-generator set. Both exciters are compound wound. An additional motor-generator will be installed with the new generator.

There are three step-up transformers of 200-kw each, of the vertical air-blast type, wound to transform a voltage of 605 to 20,000, and having a full-load efficiency of 97 per cent. The transformers are placed over a brick conduit 6 ft. wide and 10 ft. deep, both primary and secondary connections being made through this. The connections from the generator to the switchboard are made through vitrified conduits.

The switchboard of blue Vermont marble is of the latest type. It is supplied with two sets of bus-bars, double-throw oil switches, expulsion fuse blocks, etc. The switchboard is placed over the conduit in such a manner as to facilitate connecting to transformers and generators. The 20,000-volt switches are of the knife-blade type, and they, as well as the expulsion fuse blocks, are provided with large marble barrier plates.

The boiler equipment consists of two batteries, each consisting of three 175-hp return tubular boilers, built to stand a working pressure of 125 lbs. This type of boiler was used on account of the very poor quality of feed water. The boilers were supplied by the Denver Engineering Works.

Coal from the coal company's tipple is fed from a weighing hopper direct into a Jeffrey conveyor, which delivers it into steel coal bins above the boilers, the bins having a capacity of 100 tons. From the bins the coal is drawn through spouts at convenient points in front of each boiler. A coal crusher is provided so that, in case the supply of slack is not sufficient for the demands of the plant, mine run can be handled. An ash conveyor delivers the ashes into a storage hopper from which they are drawn into a steel ash car, a switch being provided so that this car can be run over the coal mine track to the waste dump. With this coal and ash arrangement one man per shift easily does the firing. The coal crusher, ash and coal conveyor are each driven by a 10-hp induction motor.

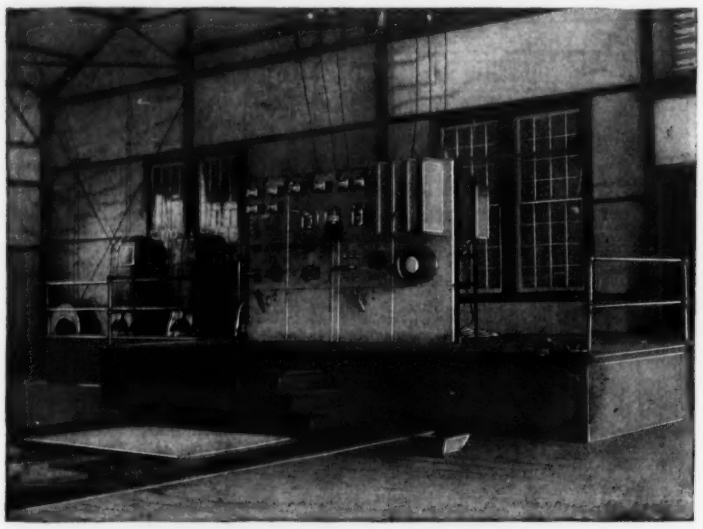


FIG. 5.—INTERIOR OF GENERATING STATION.

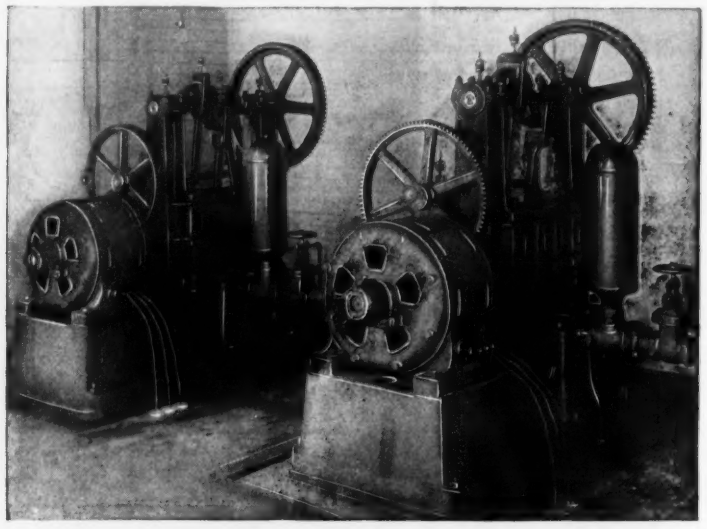


FIG. 6.—INTERIOR OF PUMPING STATION.

Until within the last two or three years there was no market for the slack coal made at the mine, and hundreds of tons of it were dumped at a point near the power house. This furnishes an ample reserve supply in case the mine is shut down, and was used for about two months last summer during a strike. While the slack has been exposed to the weather for 5 or 6 years no trouble is experienced in using it beyond the trouble of loading it into wagons.

The smoke stack is of steel, 72 inches in diameter and 150 ft. high. It is placed in the center of the building between the two batteries of boilers. The Gillette-Herzog Manufacturing Company supplied the stack, storage bins, water tanks and building. The latter consists of a steel frame covered with wire netting, asbestos paper and corrugated iron.

The pole line is designed to eventually carry two circuits of No. 4 wire, the three wires of each circuit being placed at the points of an equilateral triangle, the distance between wires being 24 inches. A telephone circuit of No. 12 hard-drawn copper is placed 5 ft. below the power circuits. The power circuits are transposed every half mile, the telephone every five poles. No difficulty is experienced from inductance on the telephone circuit. The poles on the line are spaced 100 ft. apart. Owing to the fact that the line crosses several arroyas at right angles and for several miles is constructed through a narrow, rocky cañon, poles varying in length from 20 to 40 ft. were used to reduce the strain due to vertical angles. The poles used under normal conditions were 28 ft. long. The butts of the poles for 2 ft. above and below the ground were treated with "carbolineum." The line crosses the Galisteo and Rio Grande Rivers, and as both these streams are subject to heavy floods annually it was necessary to support the line on towers located on the banks as far as practicable above the water level; hard-drawn copper wire is used for these spans, which are about 400 ft. long.

It was with great difficulty that a survey of the line could be made through the cañon because of its rough and precipitous sides, and the construction of the line presented several obstacles such as blasting holes in rock ledges where there was hardly room enough for a man to stand; hauling poles with tackle several hundred ft. up the sides of the cañon; material having to be carried on men's backs for long distances over sections where it was impossible to get pack mules. On one section the heavy pine timber made it necessary to clear a right of way for several miles, some 6000 trees being cut out. There are now no trees on the line that in falling could strike the wires. The timber thus cut was purchased from the owners of the grant and used at the Albemarle mine for stulls, lagging and cord wood.

An idea may be had of the character of the country from the fact that there is but one point on the line where water can be obtained, and but one where there is a house within many miles of it. Poles for the entire line were hauled on wagons from a point near the Albemarle mill. A saddle trail was constructed along the line and telephone stations are located every four miles; a supply box is placed at each station, and in it are kept all materials required for repairing that section of the line. Extra poles are also placed along the line at intervals. Glass insulators of the Provo type, manufactured by the Hemingray Company, were used, mounted on special locust pins, which were boiled in paraffine. The cross-arms are of selected Oregon fir and angle iron cross-arm braces were used. Great care was exercised in the erection of the line, and up to the present time there has been no interruption of the service due to line trouble. The energy loss in the line when delivering 600-kw to the mine is 8.5 per cent.

The equipment at the receiving end of the line consists of three 180-kw transformers, reducing the potential from 18,500 volts to 605. The transformers are of the vertical air-blast type. A distributing board of blue Vermont marble is equipped with primary and secondary switches for each motor circuit, and the necessary instruments. This apparatus is placed in a fireproof building with the electric hoist and a motor-driven air compressor. The air compressor is a Sargent-Ingersoll $22\frac{1}{2} \times 14\frac{1}{2} \times 18$ in., fitted with an air regulator, and operated by a 150-hp induction motor. The receiver pressure is 90 lbs.

The electric hoist was manufactured by the Lidgerwood Manufacturing Company. It is a double drum, and is arranged so that cages can be run balanced or independent, as desired. The drums each carry 1000 ft. of 1-inch rope, and the rope speed is 840 ft. per

minute. The shaft has a slight incline. The weight of the cage is 1762 lbs., and the weight of the loaded car 1825 lbs. A 100-hp induction motor is geared to the hoist by means of a rawhide pinion and operated at 450 r. p. m. The motor is of the variable speed type, with controller and resistance. By means of the controller the resistance in the secondaries can be varied and the direction of rotation reversed, and no sudden jerk is experienced in starting the cage. Three hundred and fifty tons of ore per day of 20 hours can be readily handled with this hoist from a 500-ft. level. The gearing was originally so proportioned as to give a rope speed of 1000 ft., but owing to the short lift it was found that very little more ore could be hoisted than at a speed of 840, and as the current required to accelerate was excessive, the gearing was changed.

The crushing mill is in two sections, each section forming a complete mill for crushing, rolling, drying and screening ore to 40 mesh. Both sections were, however, dependent on one line shaft to which they were belted, this shaft being driven by a Corliss engine. In designing the motor equipment this shaft was divided in the center and a 150-hp motor belted to each section, thus making two complete mills with independent motive power. The mill when treating 350

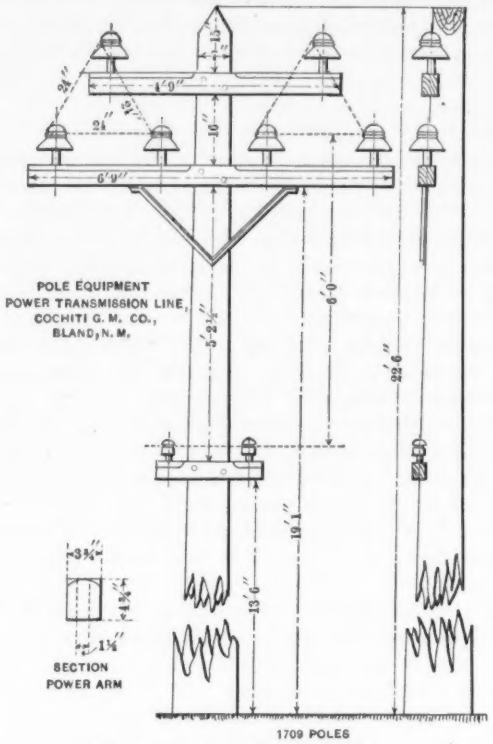


FIG. 7.—POLE AND CROSS-ARM.

tons of ore per day requires a maximum of 230 hp, this amount varying slightly with the character of the ore.

The motors at the receiving end of the line are:

1—150	hp	for compressor,
1—100	"	for hoist,
2—150	"	for mill,
1— 20	"	for saw mill,
2— 20	"	for Peletin tanks,
1— 10	"	for solution pumps,
1— 10	"	for machine shop,
1— 1	"	for transformer blower,
10	"	for lights.

Making a total of 621 hp.

At the generating end the motors are:

1— 20	hp	for motor-generator set,
1— 10	"	for coal conveyor,
1— 10	"	for ash conveyor,
1— 10	"	for coal crusher,
1— 1	"	for transformer blower.

At the pump house, 14,000 ft. from the power house, there are two 10-hp, 450 r. p. m. motors geared to triplex feed pumps for forcing water up to power house, and one 10-hp motor belted to an artesian deep well pump. This makes a total of 702 hp in induction motors. They are all supplied with oil switches and expulsion fuse blocks. The 150-hp motors are mounted on sub-bases and have outboard bearings.

The demand on the power plant is for continuous service. It is the intention to shut down for an hour on Sunday mornings in order to take up wear and make any necessary adjustments. At times, however, the engine has run 21 days without interruption. When the additional engine is in place one unit can be cut out for repairs during periods of light load, which occur when the miners are out between four and seven in the morning. The old steam equipment at the Albemarle mine and mill was left intact, and the changes required for motor driving so arranged as to permit of either being used on short notice, thus avoiding the necessity of installing a duplicate unit at Madrid. The new Navajo mill will, in connection with the compressor plant, haulage system, lights, etc., require about 500 hp.

The plant was designed and constructed by the writer. The General Electric Company furnished the electrical equipment.

Cost of Current in Massachusetts.

The gas and electric light commissioners of Massachusetts have submitted to the House a communication in response to the order which was pased by that body recently. The order asked the commissioners to state the cost of manufacturing and distributing electric light, and what, in their opinion, is a fair and reasonable price for consumers to pay for the same. In answering they say the order as passed presents peculiar difficulties in the way of a clear and specific reply. "As we understand it, it is general in character and does not apply to any particular company or locality, and requires a statement of the cost per kilowatt-hour, the unit in common use. There is necessarily a considerable variation in the different companies under different conditions, in the class of both manufacture and distribution, and there is no standard of cost in either of these departments which is applicable to companies generally.

"The cost of generating varies materially acording to whether water power or steam power is used. If the latter, the pipe or steam plant in use, the cost of fuel and ample water supply, the relation of the ordinary to the maximum demand and the conservative steadiness of the daily station road, are important factors affecting the generating cost. Using the term distribution in its strictest sense, the variable factor of most importance affecting the cost is probably the relation of the volume of business to the area in which the electricity is supplied. If the term distribution be used in the wider sense to include all the cost outside of the station, such as management and taxes, the volume of business and the value of the plant and the relation of these two to each other are important in determining the cost per unit. When the fair and reasonable price to the consumer is to be determined, not only these variables to the cost of production and distribution are to be considered, but the necessary charges for such depreciation as may not be provided otherwise together with interest or dividends upon the investment.

"The last named is frequently of more importance than any of the others and may vary more than the others according to the relation of the volume of business to the investment. From data in the annual returns it appears that the cost at the station or cost of manufacturing varied during the year, ended June 30, 1900, in different companies from less than 2 to more than 7 cents per kilowatt-hour; the cost of distribution, including management, from 1 to nearly 6 cents, while the dividend cost varied more widely.

"These facts indicate the difficulty of applying to companies generally any definite statement of costs and the necessity for a careful analysis of local conditions before attempting to determine the fair and reasonable cost per unit of these items in any particular company. These suggestions, we trust, explain our inability to reply to the inquiry as specifically as we would wish and as may have been expected when the order was passed."

Automobile Lecture.

The Library Committee of the Automobile Club of America announces the following lectures to be delivered at the new clubrooms, Fifty-fifth Street and Eighth Avenue, on the dates named. The lectures will begin promptly at 9 p. m. Members are at liberty to bring one friend with them, but not more than one to these lectures: Feb. 26, 1901, by Mr. J. A. Kingman, on "How to Operate and How to Care for a Steam Automobile"; March 12, 1901, by Mr. C. J. Field, M. E., on "How to Operate and How to Care for a Gas Engine Automobile"; March 26, 1901, by Mr. A. L. Riker, on "How to Operate and How to Care for an Electric Automobile."

Development of Motor Fans.

By Alton D. Adams.

EARLY FAN MOTORS.

SMALL motors appear to have been used during some years for other purposes before disk fans were extensively mounted on the armature spindles. Machines of one-eighth nominal electrical horse-power and smaller were first designed to operate with battery currents, and at pressures of a few volts. Gradually as electric service with constant current and incandescent lines at constant pressure extended, the small battery motors were wound or remodeled for the higher voltages.

These small motors are mentioned in the very early electrical publications as suited to furnish small powers to sewing machines, dentists' tools and even for belt connection to ventilating fans. In the first issue of the *Electrical World* in 1884 occurs one of the first accounts in public print of an electric motor with a disk fan mounted on its shaft. That this innovation was not considered of any great importance at the time is sufficiently shown by the fact that the columns of the *World* contain no further description of equipment in this line until 1887, during which year several fan motors are shown and briefly described. The use of fan motors evidently remained quite limited up to and through 1890, as very little is said in the catalogues and advertising matter sent out by the leading electrical manufacturers prior to 1891 concerning them.

The early battery and fan motors were in most cases made by small concerns, which have since gone out of business. Looking back at the construction and probable efficiency of the machines they made, the greatest wonder seems to be that they were ever able to exist at all. Among the very early fan motors were one or two exceptions to the generally poor construction, but these were in a sad minority. Some of these early motors had the Siemens shuttle armature with a solid core of cast iron and a two-part commutator. Others were provided with pole armatures, a coil being wound on each pole. The magnet frames and cores were cast iron in almost every case. After the solid Siemens and pole armature cores came the Gramme ring. These Gramme coils were a great improvement over those they preceded, because they provided lamination of some sort, either by means of fine iron or thin wrought iron disks. With the Gramme ring came commutators with six, eight or more segments, and there were no longer "dead points" at certain positions of the armature.

A difficulty that clung to the fan motor during some years lay in the high magnetic resistance of the air-gap. The fine wire with which armatures were wound required a relatively thick covering of insulation, and the great number of layers on some of the armatures made matters worse. To offset this disadvantage magnet coils with a watt consumption too large for their radiating surface were not uncommon, so that in certain once prominent makes of fan motors the destruction of the magnet coils from too high a temperature was much more common than a burned out armature.

After 1890 the importance of the fan motor as a means of air movement and ventilation gained rapid and increasing recognition from both manufacturers and the public. About this time some of the largest electrical manufacturers turned their attention to the production of fan motors and the output increased rapidly. It had long been the general practice to call any small motor, that operated a fan on its spindle, ⅛ hp. This was probably because such motors usually consumed ⅛ hp or more of electrical energy; what mechanical energy they actually imparted to the fan no one seemed to know. With the rapidly extending application of fan motors, that preceded by one or two years the World's Fair at Chicago, there was a decided movement to better their construction and lower their cast. These efforts have not ceased up to the present time, and their result is seen in the comparatively cheap and efficient fan motors of the present day.

Thus far mention has only been made of motors for direct current, of which perhaps all of those brought out before 1890 were examples. Since that date alternating-fan motors have developed.

THE DESIGN OF FAN MOTORS.

Good fan-motor design must combine three conflicting properties: very small capacity, moderately good efficiency, and low cost. It may be fairly said that the difficulty with which low cost is added to efficiency in electrical machinery grows at a rapid rate as capacity decreases. Reasons for this fact in connection with fan motors are evident on consideration of their several parts.

Take first the motor for direct current. The laminated armature core of soft iron should be slotted to provide room for the coils, and at the same time keep the gap from iron of armature to iron of poles very short. So short must this air-gap be that slots with parallel sides are impracticable, because their width would lead to uneven armature torque, local current in the poles, and low efficiency. Not only must the slots in a fan-motor armature be much narrower at the periphery than they are nearer the center, but the size of these slots, compared with that of the core, shows a great increase over the case of larger machines. A large part of such increase is due to the proportion that insulation bears to the diameter of very small wires. For a No. 10 magnet wire, B. & S. gauge, of .1019-inch diameter, the ordinary total thickness of .01 inch for double cotton insulation adds only one-tenth to the diameter of the bare copper. Quite different is the case for a No. 30 wire, B. & S. gauge, such as might properly be used to wind the armature coils of a 220-volt fan motor. Selecting silk instead of cotton as the insulation of this No. 30 wire, because the double silk covering can be put on with a total thickness of only .005 inch instead of the .01 inch necessary for double cotton, it appears that even this thin insulation adds 50 per cent to the diameter of the bare copper. If the silk-covered No. 30 wire is wound so that no space is lost—that is so that each convolution lays close to those on each side of it—the coil space, leaving out that occupied by air between the round wires, is taken up by copper and insulation in the proportion of $(.01)^2$: $(.015)^2 - (.01)^2 = 1 : 1.25$. In other words, the copper alone takes up less than one-half of the actual space occupied by the insulated wire. These fine wire coils must be wound on the core by hand, so that the cost of the fan-motor armature, as to both material and labor, is large in proportion to its size.

Another element of necessary expense, large compared with the selling price of a fan motor, is the magnet coils. These coils are necessarily of very fine wire, and while the use of silk insulation may in some cases be avoided, the cost of the wire for motors to operate at 110 or more volts is large per pound with only cotton covering. To build the small commutator required for a fan motor, having the segments few enough to keep the cost low, and their number large enough to prevent injurious sparking, so that all the parts are rigid and the insulation high, is a nice problem in engineering.

Unless reduced to their simplest forms the magnet frames, bearings and connections of fan motors are sure to require a total labor expense that is prohibitive. With these general difficulties in mind, the essential features of successful fan-motor design may be considered.

In the design of a fan motor, as in that of any other, it is usually most convenient to start with the armature core and coils. The minimum speed of revolution with no external resistance in the armature circuit is known at the start. A certain portion of the line pressure is allowed for the drop in the armature coils when the maximum current is flowing, say, 10 per cent in the case of a fan motor for a 110-volt circuit, or 11 volts, and this voltage must be deducted from that of the line to determine the pressure available to overcome the counter electromotive force of the armature coils and the resistance of the magnet winding. Another portion of the line pressure, perhaps again 10 per cent, must be deducted to cover the drop with full current between the terminals of the magnet coils. These two deductions, to provide for the ohmic resistance of the armature and magnet coils leave that portion of the total line pressure which must be equalled by the counter electromotive force of the motor armature. This counter electromotive force is the voltage that must be set up in the armature coils, by their revolution at the predetermined speed and by the magnetic flux passing through the armature core. Since an increase of either the number of times in the armature coils, or an increase in the armature flux reduces the speed where other factors remain constant, the problem of armature design is largely that of the best combination of these two elements.

Bipolar construction is decidedly superior to multipolar for fan motors. Owing to the small capacity of such motors, their parts for even bipolar machines are too numerous and multipolar design would increase the number of and the labor on these parts beyond any possible compensating advantage.

The iron of the armature core and its coils should therefore be proportioned for a bipolar magnet. The number of slots in the armature core and of segments in the commutator will obviously be smaller, for satisfactory operation in a bipolar than in a multipolar fan motor. As the armature coils must be wound upon the core by hand, it is usually better for the sake of safe insulation, in the case of a drum armature, to wind one coil into every slot before winding

the second coil into any of them. If a ring armature core is used, it is probably cheaper and safer to wind only one coil into each slot, though some prefer to employ a very large slot and bring out a loop when one-half of the wire is in, so that each slot holds two coils.

Relative advantages of drum and gram armatures for fan motors have received much attention at the hands of designers, but there now seems to be little doubt as a general rule that the drum armature is cheaper and more desirable for the purpose. The ring core is necessarily larger in diameter than a drum core of equal section, it must be mounted on a bronze spider that is in turn fitted to the shaft, and, in winding, a bobbin must be used to pass each turn of wire through the central opening, unless the ring core is divided into two or more parts. A drum core, on the other hand, being mounted directly on the shaft without the intervention of a spider, there is no reason to divide the core, but the coils are wound into the slots with wire as it comes from a suitably mounted reel. The commutator of a fan motor should be constructed with the same regard to high insulation and rigid mechanical properties that prevails with larger machines. Mica alone is the material that has proven satisfactory for commutator insulation, and it should be exclusively employed for that purpose in fan motors. The segment may be of either drop-forged or drawn copper, but the cast variety is not desirable for the purpose. Various inferior methods of construction, common a few years ago in the commutators of fan motors, cannot now be tolerated. Among these may be mentioned a commutator, made by the insertion of round copper wires in a block of hard fiber, so as to form a circular group, the copper and fibre being subsequently turned to a bearing surface for the brushes. The number of segments in the commutators of fan motors varies from 8 to about 20, the tendency being toward the larger number in machines of the better class and those for the higher voltages.

Practice has quite generally settled on two types of bipolar magnet frames for fan motors. These are the simple U-magnet, with an armature at the top, and the iron-clad magnet with two inwardly projecting poles. The U-magnet possesses the advantage of smaller weight for a given sectional area and length of winding space for the magnet coils, it also raises the center of the armature high above the base of the motor, so that a fan wheel can swing clear, though no pedestal is employed. On the other hand, the iron-clad motor is more easily and cheaply enclosed to protect it from dirt and mechanical injury than is the U type, and some prefer it for this reason. The section of the magnet frame in any case should be large enough to supply the magnetic flux necessary in the armature core, plus one-third to one-half of that amount lost as leakage.

Wrought iron in the form of drop forgings, or stampings of wrought iron or soft steel, are the materials most suitable for the magnet frames of fan motors. Steel castings are the next best material, but they are not so desirable because of the greater labor required to finish and their somewhat lower permeability. The outer casing, in which the magnet frame and armature of a fan motor are often contained, and also the base or pedestal that serves to elevate the motor shaft so that the fan will swing free, is most easily and cheaply made of cast iron. Carbon is, of course, the only suitable material for the brushes of fan motors, and the square or rectangular form, sliding automatically through holders of similar shape, is most suitable and least apt to give trouble. Brush holders may well be mounted rigidly in suitable extensions on the bearing nearest the commutator or in the iron end plate that not only supports the bearing but also encloses the motor at the commutator end. Shaft bearings are perhaps best lubricated by a wick, held in position by a spring and dipping into a small cylinder of oil attached to the lower side of the bearing.

For enclosed fan motors the end plates, and for open motors some part of the cast-iron base or frame usually offers the best support of the binding posts, which should, of course, be mounted with suitable washers and bushings of insulating material. One of the prime requirements in a fan motor is durability, and to this end the total number of parts should be reduced as much as practicable, and each part given ample strength. As the fan is constantly attached to the fan motor, the magnet windings may be and usually are connected in series with the armature without any danger that an excessive speed of revolution will ever be reached. The revolution of the fan dos not require a constant torque, but the necessary turning effort, small at first, increases more rapidly than the speed, which is thus checked when the predetermined flow of current in the magnet coils takes place.

Speed regulation for fan motors may be readily effected by changes in the magnet coil connections, or by the use of a separate resistance in series with the armature and magnet windings. Three different speeds may be obtained, where two magnet coils are used, by means of a switch that connects the coils to the armature and line in three different ways. For the lowest desired speed the two magnet coils should be in series with each other, so that the entire armature current flows through each. In this case the ampere-turns on the magnet frame are at their maximum, and consequently the magnetic flux through the armature is greatest. The armature speed is now at its lowest point, not only because of this maximum magnetic flux, but also on account of the drop in volts between the magnet coil terminals. For a medium speed one of the series magnet coils is cut out of the circuit. This reduces the loss of pressure in the magnet winding, raises the volts at armature terminals and decreases the ampere-turns on and the flux in the magnets and armature core, hence the speed rises. When the highest speed is wanted the switch is turned to a third position which corresponds to the connection of the two magnet coils in multiple with each other, and in series with the armature.

By this connection the ampere-turns on the magnet frame are increased somewhat, because the motor current is somewhat larger than at the lower speeds, but as the resistance of the circuit through the magnet coils is only one-quarter of what it was when the two coils were in series with each other the volts at the armature terminals reach their highest point, and the maximum speed results.

If speed regulation is accomplished by an external resistance, the connection of the armature and magnet coils remains constant, and the amount of resistance in series with them is varied by the movement of a switch so as to give different voltages at the free terminals of the armature and magnet coils.

The necessary capacity of a fan motor, of course, depends on the size and character of the fan to be operated, as well as on its maximum speed of revolution. Electric motors generally have their capacities stated as their actual rates of delivered work, but fan motors are commonly rated by the diameters of their fans. Brass fans 12 to 16 inches in diameter and with four blades each are the sizes most common with fan motors, and about 1500 r. p. m. is about the usual maximum speed. The work absorbed by each of these fans at the stated speed, as well as the volume of air moved per minute, depends, to a large extent, on the shape of the blades and on the angle at which they are set with the plane of revolution. The best way to determine the power necessary for any particular fan is to measure the watts consumed by the motor operating it, find out the efficiency of the motor for that particular load and speed, and then calculate the power delivered to the fan itself from this data.

A fan of the ordinary variety, having four blades, and 12 inches in diameter, can be driven by a good fan motor that consumes not over 60 watts direct current. A fair efficiency for a motor that consumes energy at this rate under maximum load is 30 per cent. On the basis of these figures the motor delivers to the fan mechanical energy at a rate equivalent to $60 \times .30 = 18$ watts. With motors that operate 16 or 18-inch fans, having blades so shaped that as much as .1 or .125 actual horse-power is necessary to drive them, efficiencies as high as 50 per cent may be obtained.

Fan motors for use with alternating currents of single phase are mostly of the induction type. In these machines the armature core may be said to constitute one part of the magnetic circuit of a transformer, and the magnet frame of the other part. The primary winding, that is, the one connected to the supply line, is represented by the magnet coils; the secondary circuit is made up of copper rods embedded in the armature core and put into good electrical connection with each other by riveting them into brass or copper-end plates. When the primary or magnet coils are supplied with alternating current, a current is induced in the rods and plates that make up the secondary circuit. The mutual reactions between the several parts of the secondary circuit, represented by the circle of copper rods embedded in the armature core, and the magnet poles operate to give the armature a continuous torque. It should be noted in this construction that the revolving armature has no electrical connection whatever with the supply line or the magnet coils. It follows that no commutator or sliding contacts of any kind are necessary with these motors. The armature cores for these alternating motors must be of laminated iron or steel, as in those for direct current, and the required amount of iron is so small in comparison with the diameter that the disks should be mounted on spiders. Slots in the core to receive the copper rods are of about the same form as would be used in an armature for direct current, but they are usually more numer-

ous. The electromotive forces induced in the copper rods of the armature cores are so small that insulation between these rods and the disks of the cores is not considered necessary.

As the magnet coils of these alternating motors take current from the line, the magnet frames must be laminated like the armatures, to prevent serious loss from the local currents that would result in a solid mass of metal. Unlike the direct-current magnet frames, those for the alternating motors should have four or more poles each. This construction is readily adapted to enter a circular cast-iron core having a diameter two or three times as great as to thickness, which is now the prevailing outline for alternating fan motors. The magnet coils must be designed not only for the voltage of the circuit for which they are intended, but also for its rate of alternations or cycles per second. At present motors of 60, 125 and 133 cycles per second are the ones generally demanded. Means by which a speed of about 1000 as well as a maximum of 1500 r. p. m. should be provided, and this result is usually attained by a three-contact switch in the base of the alternating motor, that combines the magnet coils in two ways.

PRESENT FAN MOTORS.

Perhaps no class of electrical machinery has made greater advances as to pleasing outline, internal construction and efficiency than fan motors during the last few years.

The great variety of shapes given these little machines in past times, each usually claimed to have some special virtue, has mostly given way to a not unpleasing uniformity that includes protection to the working parts of the motors, a compact arrangement of parts and not unsightly proportions. The old shuttle armature with its dead points and the more common Gramme ring with its smooth core and surface winding have almost entirely disappeared. With the surface windings have gone the long air-gaps that made magnet coils heavy in copper and expensive in current consumed. For direct-current fan motors the slotted drum armature core now holds the leading position. In magnet frames cast iron has given way to drop forgings and to stampings of thin wrought iron or steel. Magnet coils, once wound directly on their cores, are now made complete and insulated before they are applied to the machines, thus rendering the parts interchangeable. Carbon brushes and well-constructed commutators do away with any attention at these points for weeks and even months at a time. Oiling devices of the most crude pattern have been replaced by automatic supplies that often last during a season. Efficiency has risen from an unmentioned and often an unmentionable quantity, to a respectable figure for machines of such small capacities. Alternating-current fan motors, little heard of until the latter half of the present decade, are now doing an enormous amount of work in places where direct current is not available. Various methods of mounting fan motors make it possible to operate them when placed upright on a desk or counter, to turn the axis of the fan so that the movement of air is directed toward any part of a room, support them from side walls and even to suspend them from ceilings. Meantime, the demand for these machines has so increased that their manufacture requires an important department in the works of the largest companies.

A New York State Electrical Laboratory.

A bill is before the New York State Senate for the establishment of a laboratory of electric engineering in connection with Union College in Schenectady. It proposes an appropriation of $150,000 for the erection and equpiment of the laboratory and $25,000 a year for its maintenance. In consideration of this appropriation—which is the equivalent of $30,000 a year—the State is to have the title to the land and 25 four-year free scholarships annually in electric engineering at the college. The selection of Union College is determined by the fact that the works of the General Electric Company are situated at Schenectady, and from them extraordinary facilities are to be obtained.

Pacific Cable.

A start towards constructing the cable from San Francisco to the Philippines was made recently by Mr. Perkins offering, in the House of Representatives, an amendment to the sundry civil bill for an appropriation of $500,000 to secure terminal rights for the United States.

European Types of High Tension Alternators—VII.

By C. F. GUILBERT.

BOUCHEROT ALTERNATOR.

A BOUCHEROT alternator exhibited at Paris (Figs. 69, 70 and 71) by Breguet et Cie, was driven by a high-speed Delaunay-Belleville engine and, as in the case of the Grammont alternator, was supplied with a special exciter designed to maintain the

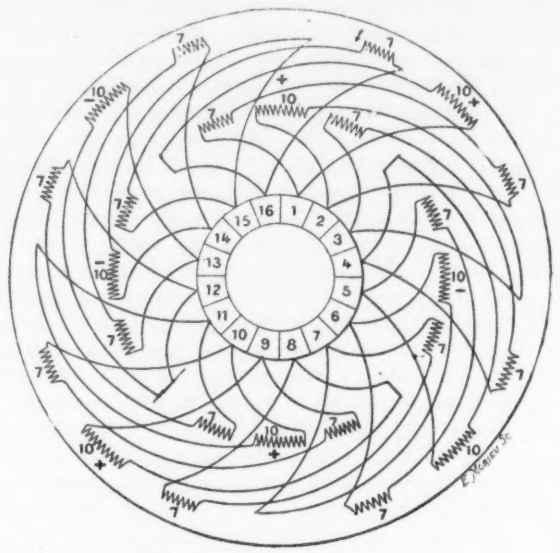


FIG. 67.—WINDING FOR K = — 2.

voltage at the terminals constant whatever the current output or phase relation. While, however, the Grammont alternator is an ordinary machine with a low drop, the Boucherot alternator has been designed with a special view to its application as an asynchronous generator, and consequently involves some special features. It is, in brief, as in the case of induction generators, analogous to an asynchronous motor and consequently its fields and armature are analogous to the field and armature of an induction motor.

The fixed armature (which would be the field of an asynchronous motor since it is connected to line) has an ordinary three-phase winding. The field (analogous to the armature of an asynchronous

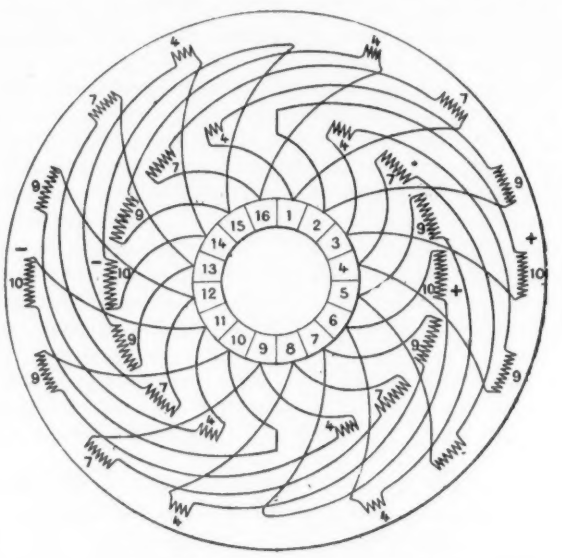
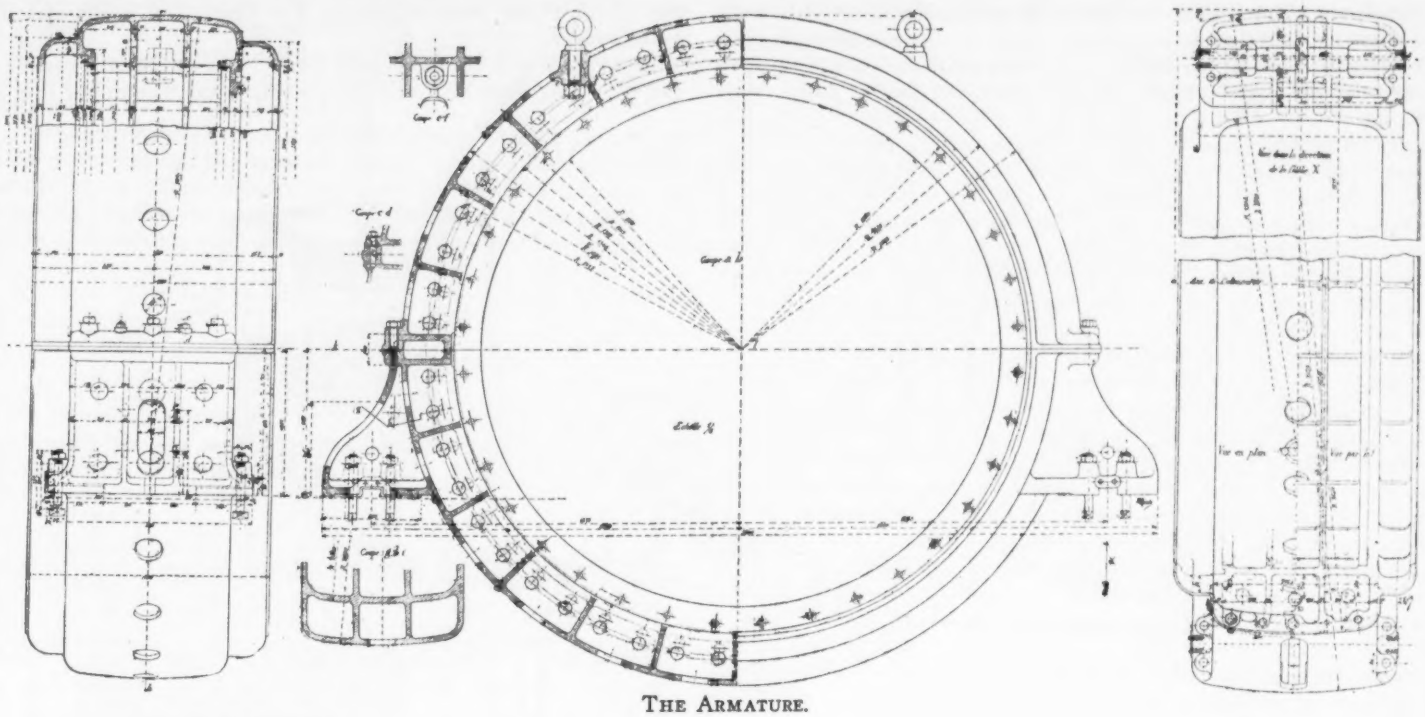


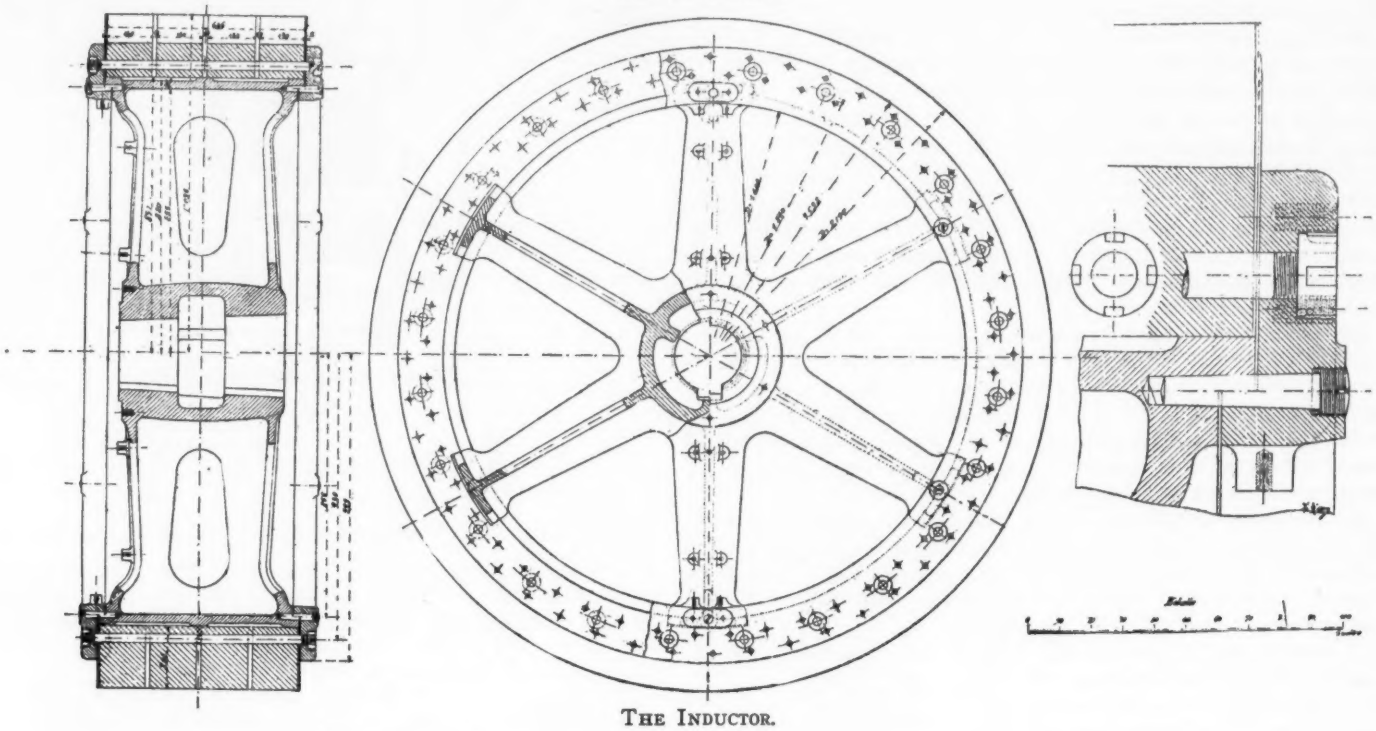
FIG. 68—WINDING FOR K = I.

motor) is wound two-phase and consequently comprises two identical circuits in quadrature, of which only one was utilized at the Exposition though both will be employed when the alternator is permanently installed. In addition to these features the alternator presents a special interest from the manner in which it is excited.

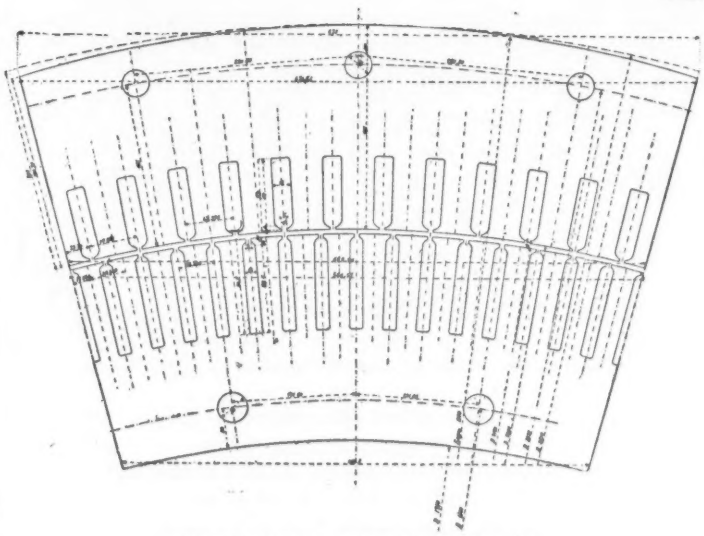
In the account of the Leblanc exciter we have seen that the condition of compounding is the proportionality of the voltage at the terminals of the exciter to the voltage induced in the alternator, on the supposition of non-saturation of the magnetic circuit of the latter, which also applies to the present case.



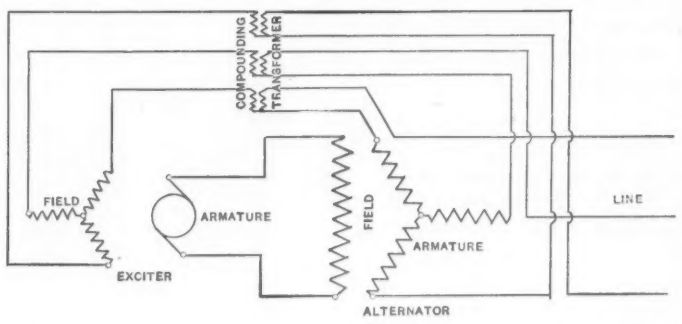
THE ARMATURE.



THE INDUCTOR.



SECTION OF INDUCTOR LAMINATIONS.



GENERAL CONNECTION OF ALTERNATOR AND EXCITER.

FIGS. 69 TO 72.—BOUCHEROT ALTERNATOR.

While in the Leblanc exciter the flux in the field is the resultant of two fluxes of appropriate amount and phase relation, in the Boucherot exciter the field flux, which is also rotary, is obtained by impressing on the terminals of the field circuit of the exciter a voltage equal to the resultant of the voltage at the terminals, and another proportional

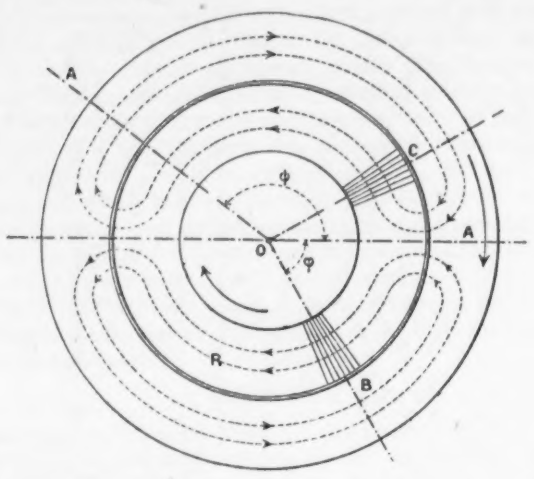


FIG. 73.—PRINCIPLES OF SINUSOIDAL DYNAMO-WINDING.

to the current and shifted in phase with respect to the first by an angle equal to an appropriate function of the phase difference. This voltage is obtained as in several methods of compounding converters by a transformer in series with the line and called a compounding transformer (Fig. 75).

The exciter of M. Boucherot, like that of M. Leblanc, is so designed that it does not require the number of field poles to be equal to that of the alternator if the exciter is mounted on the same shaft with the alternator; or to have a ratio equal to that of the angular speed of the two machines if they are not on the same shaft. The means employed by M. Boucherot to give to the number of poles any simple ratio is based on a principle quite different from that of M. Leblanc, and is as follows:

Let us consider (Fig. 73) a machine, bipolar, for example, composed of a fixed part having the winding of a polyphase motor and a moving part consisting of a ring identical with that of a direct-current machine, but which, instead of having a distributed winding, as in the case of a Gramme ring, carries two windings, the sections of which have a variable number of turns along the periphery of the armature following a sinusoidal law.

If we connect the sections among themselves and to the segments of the commutator in such a manner that between two consecutive segments of the commutator we have in series a section, B, having a number of turns equal to $n = cos\ k\ \phi$ (ϕ being the angle of the section with any section taken for origin and n and k any numbers); and a section, C, at an angle of 90 degs. from the first and having a number of turns equal to $n = sin\ k\ \phi$. The connections, as a whole, will present, according to one of the diagrams given, figures corresponding to values of 1 and $-2nk$. Calculation will show that if the commutator is supplied with brushes regularly spaced such that consecutive ones of different polarity have between them an angle ψ defined by the relation

$$\psi = \frac{\pi}{k+1};$$

the e. m. f.'s induced in the circuits in parallel coming under the brushes are equal and have for an expression

$$E = \frac{2\,n\,e}{k+1}\,(a-\omega)\,cos\,(\omega - k\,a)\,t,$$

where e is a constant depending upon the field flux, ω the angular speed of the rotary field turning in the direction of the arrow, and a that of the exciter armature, turning also in the direction of the arrow. In the particular case where the speed of the field flux and of the armature satisfies the relation, $\omega + k\,a = O$, the expression for the voltage at the brushes becomes $E = 2\,n\,e\,a$, and is consequently continuous.

Two values of k are more particularly to be considered, namely, 1 and —2. The value of $k = 1$ corresponds to the diagram of Fig. 67,

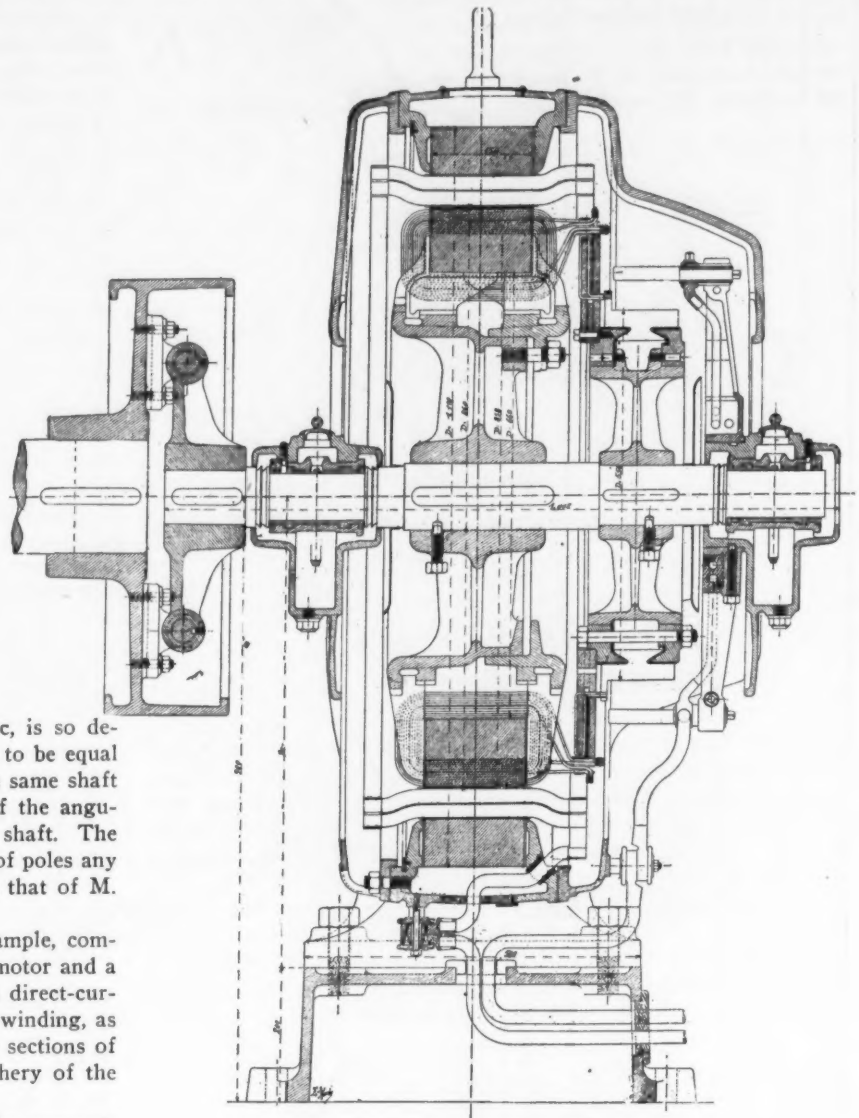


FIG. 74.—BOUCHEROT EXCITER.

and indicates the possibility of exciting the alternator with a single-alternating current. Every single-phase field can, as has been pointed out by M. Leblanc, be regarded as the resultant of two fields turning

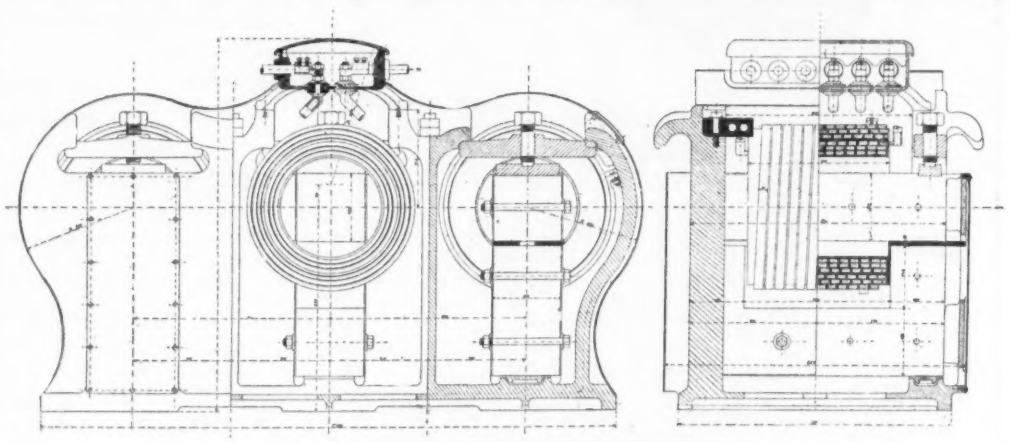


FIG. 75.—BOUCHEROT COMPOUNDING TRANSFORMER.

in opposite directions with velocities equal to ω. One resultant has the same speed as that of the armature, and since $\omega = -a$ it will introduce no e. m. f., and consequently the condition will be as if there were only one field turning with the speed 2ω with respect to the armature.

In this case, for a bipolar exciter, there will be four brushes placed

90 degs. apart. The value, $k = -2$ (Fig. 68) is interesting, because it indicates that the exciter can turn with the same angular speed as the alternator and have half the number of poles. In this case we have ω equal to a; that is to say, the field turns in the same sense as the armature and with a double speed.

The angle of the brushes of different polarity is here $-\pi$. There are consequently but two brushes, or one per pole. This latter is the method of connection adopted for the exciter of the alternator here described. Before giving the principal dimensions of the exciter and of the compounding transformer we will say several words concerning the operation of the machine as an asynchronous generator.

We have found for the voltage between two brushes of different polarity the expression

$$E = \frac{2\,n\,e}{k+1}(a-\omega)\cos(\omega + k\,a)\,t$$

If we had placed the second series of brushes in the middle of the interval separating those of the first series we would obtain between the brushes of different polarity of this new series, a voltage having for expression in function of time

$$E^1 = \frac{2\,n\,e}{k+1}(a-\omega)\sin(\omega + k\,a)\,t.$$

That these currents may excite the alternator as an induction generator it is known that the machine should have a slip of $-\frac{\varepsilon}{\omega}$ and the exciting currents have a frequency $\frac{\varepsilon}{2\pi}$ and furnish a flux rotating in opposite direction from that of the fields with the speed ε. The direction of rotation depends on the connections.

As to the first condition, we will obtain it if we can satisfy the relation, $\omega + k\,a = -\varepsilon$, for then we will have

$$E = 2\,n\,e\left(a + \frac{\varepsilon}{k+1}\right)\cos\varepsilon\,t$$

$$\text{and } E^1 = 2\,n\,e\left(a + \frac{\varepsilon}{k+1}\right)\sin\varepsilon\,t.$$

Now, this relation is satisfied if the speed a of the armature of the exciter corresponding to asynchronism in the ratio, $\frac{\varepsilon}{\omega}$. The new speed of excitation is then $a = a_1\left(1 + \frac{\varepsilon}{\omega}\right)$

and we will then have, if we substitute the relation to satisfy

$$\omega + k\,a_1\left(1 + \frac{\varepsilon}{\omega}\right) = -\varepsilon,$$

an expression which is an identity when in asynchronism we have

$$\omega + k\,a_1 = O$$

This machine can thus operate according to a new method which M. Boucherot calls "panchronic." The machine is no longer an induction machine properly speaking, since all the e. m. f.'s of induction developed in the field by the resultant field flux are annulled. In this case the current output of the machine is no longer a function of the slip, and the power output is practically independent of the speed—consequently the name panchronic. The variations of speed, whatever the cause, have no influence on the current furnished as in an ordinary asynchronous machine, where perturbations have an enormous influence on account of the small variation of speed corresponding to the passage from no-load to full-load. The balancing of induced e. m. f. in the field by the resultant flux from the armature and the field is obtained by M. Boucherot as follows:

First, by the introduction of self-inductance variable with the slip by means of a mechanical arrangement. Second, by the introduction in the field circuit of the exciter, e. m. f.'s proportional to the slip, and obtained from a small auxiliary machine. Third, by the introduction of condensers of variable capacity into the exciter field circuits.

The exciter of the Boucherot alternator (Fig. 70) has a fixed field consisting of a cast-iron box frame carrying on the interior two cast-iron rings cast in the frame and between which are held the laminations. On the face of this frame are two projections which carry the bearings of the exciter. The exterior diameter of the field frame is 48 inches (120 cm), and its witdh 22 inches (55 cm). The diameter of the bore of the field ring is 34 inches (86 cm), the width 6 inches (15 cm), and the radial depth 5 inches (12.5 cm). The field core has 72 slots, or 6 per pole. The field winding is a 12-pole three-phase winding composed of bars of 110 mm section. The number of conductors per phase is 48, or 4 per pole. There are two bars placed one above the other in each slot. The three circuits are grouped in star and the three terminals of the field connected with a compounding transformer.

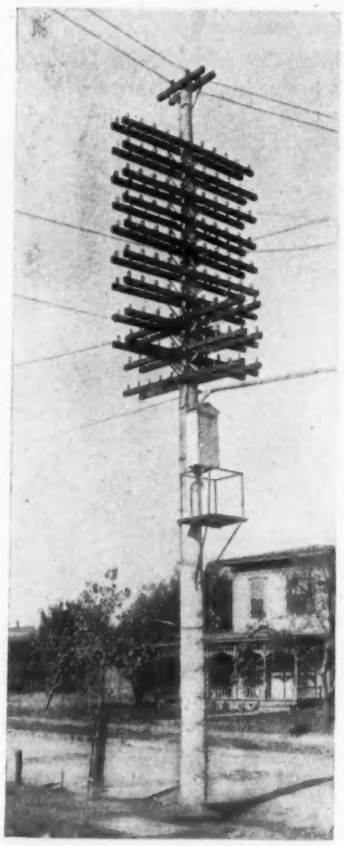
The armature ring, mounted on a spider and held by a cast-iron ring, is formed of laminations having an exterior diameter of 34 inches (85.8 cm), a width of 6 inches (15 cm) and a radial depth of 4 inches (9.9 cm). The air-gap is 1/25 of an inch. The surface has 288 slots, which receive the two sinusoidal windings, each slot carrying a coil of each winding. The number of slots per pole is 12, which is also the number of sections of windings, the turns varying from 1 to 8; the sections are connected to 288 commutator bars, according to the diagram above indicated; a connector reduces the number of brushes to two of each polarity, for each of the two circuits, or 8 sets of 4 carbon brushes each. The commutator has a diameter of 22 inches (55 cm), and a useful width of 4 inches (10 cm). The wings of the commutator are of German silver. The exciter is coupled to the shaft of a steam engine. The machine is calculated to deliver a maximum current of 180 amperes at 250 volts.

The compounding transformer (Fig 75) is formed of three single-phase transformers, one disposed alongside the other in a single case. These transformers are of the type having a single primary and a single secondary coil, both disposed concentrically and horizontally. The core is former of U-shaped laminations, connected by a straight section carrying the windings. The dimensions of the U-shaped laminations are 22 inches (56 cm) wide and 12 inches (29 cm) high. The widths of the lower part of the vertical legs are, respectively, 6 and 5 inches (15 and 12 cm). The thickness of the body of the core is 6 inches (15.4 cm).

The core forming the magnetic circuit has a width of 22 inches (56 cm), and a height of 6 inches (15 cm). There is an air-gap, adjustable by means of wedges, between the top section and the branches of the U. The primary winding is placed inside the secondary and consists of 39 turns of a copper bar of rectangular section. The secondary winding comprises the same number of turns and the same number of sections as the primary. The turns of the exterior layer are bare in order that connection with the circuit may be made on any turn to facilitate adjusting the compounding.

Telephone Pole Line Construction.

Illustrated herewith is one of the handsomest telephone cable poles it has been our fortune to see, and attention is directed to the "crow-foot" guy as a very neat piece of construction. It was erected by the Massillon, Ohio, Telephone Company, which has just been rebuilding its system, and will soon add $5,000 of cable for immediate use. The present cable capacity is 600, and will be 800 when the new cable is up. The company has also 500 miles of country lines, metallic circuit, No. 10 iron wire, connecting all of the nearer small towns from their centrals. The company has also special toll lines running to the small towns, and is further connected with the U. S. Long-Distance Telephone Company, being able to reach, all told, some 100,000 subscribers of various independent exchanges in Ohio, Indiana, Illinois, Michigan, Virginia, West Virginia, Pennsylvania and a few other States.



TERMINAL POLE.

We are indebted to Mr. W. S. Holloway, manager of the company, for these details, as well as a few others in regard to the exchange itself. The main board, made by the American Electric Telephone Company, has 600 drops, and there are already 570 subscribers. The long-distance board, with 30 drops, was furnished by the North Electric Company. The exchange has increased 200 subscribers within the last six months, and it is expected to reach 1000 this year.

Electric Railways in Tokyo, Japan.

BY PHILLIP JAISOHN, M. D.

SINCE my last article on "Electrical Possibilities in Japan," the ELECTRICAL WORLD AND ENGINEER has published data as to the contracts placed in this country for the new electric railway work in Japan. I am now glad to be able to supplement that information.

The question whether the work of providing and managing improved means of street transit in Toyko should be left to private enterprise or reserved to the municipality, has been settled by a sort of compromise between the contending principles involved in the controversy. The discussions of the question during the past two years have shown that the weight of opinion in official and academic circles in Japan is strongly and decidedly in favor of the municipal ownership and management of all works partaking of the nature of a monopoly. But in deference to the plainly expressed desire of the practical section of the public, the municipal and imperial authorities have consented to waive the point and allow private companies to build and work street electric railways for a number of years under very stringent regulations relating to the reversion of these railways to the municipality and other matters.

These regulations are embodied in the instructions issued to the Tokyo Street Electric Railway Company (by which name the amalgamated concerns have come to be known), and the Tokyo Tramway Company, whose present horse tramways are to be converted into electric lines. The documents given to these companies differ in some respects, so we shall first examine that served upon the newly established concern, namely, the Tokyo Street Electric Railway Company. The company is permitted to construct altogether 27 lines, whose total mileage, I believe, is somewhere between two and three hundred miles. The work is to be commenced within six months from the date on which official permission shall have been obtained for the plan of construction which, in turn, is to be submitted within six months from the date of the charter. The work should be completed in five years from the date of its commencement, which period may be extended by two years in case the progress of the work shall have been delayed by causes beyond human control. The gauge is to be 4 ft. 6 in. between the inner sides of the rails. The whole space included within the rails as well as a space of 2 ft. along the track is to be paved with stone, wood or asphalt, in such a manner as to keep the top of the rails on the same general level as the rest of the road.

The minimum width of streets should be 36 ft. for single and 48 ft. for double tracks. Where the streets are narrower than these limits, the company has to widen them at its own expense. But the expense required for this purpose will not be prohibitory in the case of the company under consideration, for it is provided that, in case the widening of such streets is undertaken by the city as part of its improvement scheme, long since decided upon, only one-half of the expense incurred for the necessary extension shall be borne by the company, and the routes selected by the latter happen to run principally through streets included in the above mentioned programme. The posts for the support of the electric conductors should be of iron, at least 18 ft. high and 120 ft. apart, and they should, moreover, be provided each with an electric lamp, which must be lighted from sunset to sunrise. The maximum speed is fixed at eight miles per hour, and it is provided that cars must never be joined one to another—no trailers. A provision which will perhaps be regarded with satisfaction in scientific circles, is that, within the radius of 1300 metres from the site of the new Physical Laboratory at the College of Science of the magnetic measurement room of the Central Observatory, the strength of electric current should never exceed 1000 amperes. Besides these regulations, there are minute and very strict provisions about the supervisory power of the imperial and municipal authorities over the construction and maintenance of the railways and the rolling stock, as well as over the method of business management. These provisions are so comprehensive and elaborate that it is hard to conceive the possibility of any case wherein sufficient and prompt official pressure could not be brought to bear upon the company in the benefit of the public order or interests.

As to the reversionary interests of the state or the city in the railway to be constructed by the company, it is provided that all the tracks, rolling stock and other propefty necessary for conducting the business shall revert to the state or city on the expiration of the charter, which is to take place on the 30th of June, 1952. But even before the expiration of the charter, the state or the city reserves the right at any time of purchasing or running the concern in whole or part. The purchase price in such case is to be determined by capitalizing the average amount of net profit during the preceding five years at an interest of 7 per cent per annum. For instance, taking the average amount of profit at 700,000 yen, the purchasing price would be 700,000 ÷ .07 = 10,000,000 yen. In case the lines are to be worked by the state or the city, the company shall be entitled during the period its lines are worked in that way to a compensation whose amount is to be determined on the basis of the earnings of the previous month or year. However, during the month of July 1, 1932, and during the corresponding month of every fifth year thereafter, the state or the city will have the power to demand the handing over of the company's property in return for a sum of money equivalent to the latest valuation of the property. During the time the lines are worked by the company 10 per cent of the net profits is to be set apart as reserve, and after paying out of the remainder a dividend of 7 per cent per annum, one-third of the residue, if any, is to be paid to the city. Besides, the whole property is to be forfeited in the event of the company's failure to fulfill the more important conditions specified in the document. Finally, to completely guarantee the reversionary rights of the state and city in the undertaking, the company is prohibited from mortgaging or alienating any portion of its property necessary for the conduct of its business.

The instructions given to the other company for the conversion of its horse tramways into electric lines, are substantially the same as in the document thus far reviewed. The principal points of diff rence are that the work of conversion is to be finished in two years, instead of five as in the other case, and that the clause relating to the widening of narrow streets, though worded exactly alike, will in practice entail a heavier tax upon this company than on the other one. It has already been pointed out that the railways of the other company will run through streets which are included in the city improvement scheme, and that, consequently, it will only be necessary for the company to bear one-half the expense. But in the case of the Tramway Company, it happens that the streets passed by its lines are outside the scope of the scheme, and consequently the company has to bear the whole expense, which will be especially hard, seeing that its routes traverse the most important business centers of the capital. On the other hand, it has to be remembered that the company's profits are enormous, its latest rate of dividend, which is not unusually high, being 35 per cent per annum. Unless, therefore, one has an accurate knowledge of the actual expense entailed by the observance of the provision in question, it is impossible to pronounce any opinion as to the justice or injustice of the provision. The company, however, thinks it unjust and unbearable, and it has decided to return the charter, and conduct the present concern till the end of its term which will be about ten years hence. These facts furnish an interesting insight into trolley railway conditions now existing in Japan.

Unrewarded Inventors.

Discussing the life and recent death of Dr. Elisha Gray, and his relation to the telephone, the *Iron Age* in a recent issue says: "It is natural, no doubt, to feel a great deal of sympathy for the clever and industrious inventor who benefits the world in large ways without profiting therefrom save in the sense in which all progress ameliorates the conditions of living for all who live. It is a question, however, whether such sympathy is not in great degree wasted—not because the poor inventor does not deserve it, perhaps, but because, if he is a true inventor and not a mere adapter with keen commercial instincts that for which he has least use in life is pecuniary profit. He lives in a more rarefied atmosphere than other men. Success would probably more often spoil than benefit him. He has none of the "instinct of self-preservation" which a man needs to make his stewardship of wealth of advantage to himself or to society. If able to pursue the idea which is always materializing and dematerializing just ahead of him, and which seems the one object worth pursuing, he is probably happier than he could possibly be if gifted with the Midas touch of the successful promoter. The best we can wish these richly endowed geniuses is not sordid gains, but the posthumous fame for which any one of them would sacrifice temporary and purely selfish advantage." As a matter of fact, Dr. Gray received large sums of money for many of his inventions, though not for the telephone.

The Evolution of the Electric Sign.

BY E. TRIER.

AS if it were heralding its own future, a huge electric sign mounted on the front of New York's City Hall recently flashed forth a hearty welcome to the twentieth century at the moment the old year was drawing to a close. It meant to all who have watched its evolution and growing popularity a new and important era for the electric sign, which is destined to become an important factor in the business world, serve as the herald of new commercial products and amusements, and open a large market for the electric current. The fixed, dumb sign of old is to become a living, talking bulletin, which, by means of its kaleidoscopic changes holds the attention of every passer by—a "Sign of the Times."

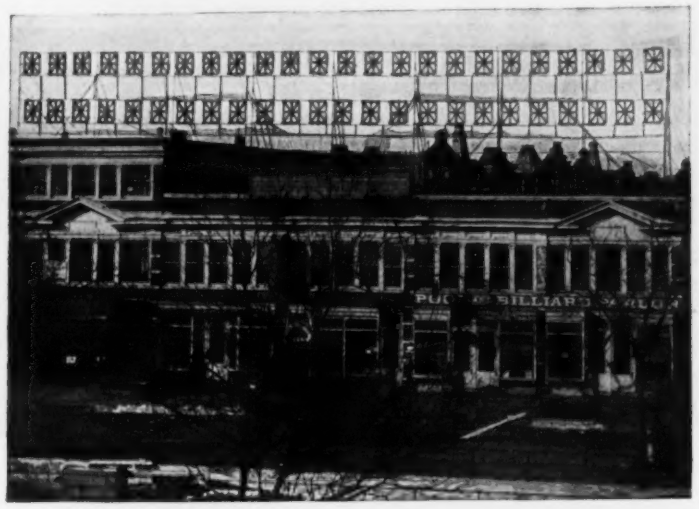


FIG. 1.—THE SIGN AS SEEN BY DAY.

It may almost be said that the electric sign has changed the nocturnal aspect of our larger cities where hundreds of signs composed of thousands of incandescent lamps are displayed against the sides of and in front of stores, places of amusement, restaurants and newspaper offices, as well as on the tops of buildings in prominent locations. As an example Broadway, between Thirty-eighth and Forty-first Streets, may be cited (shown in Fig. 2), where no less than 310 letters are displayed, composed of over 4600 incandescent lamps. At another location in New York, an electric sign is displayed for which one advertiser pays the enormous sum of $24,000 per year, which includes rental of the space and the current consumed by the lamps and the motor which drives the mechanism used for lighting and extinguishing the various rows at definite intervals.

It is nevertheless this enormous cost of operating an electric sign of this type, which in turn limits the advertiser to a short, universal announcement, which has been responsible for the fact that heretofore advertisers have considered an electric sign a great luxury and not as good paying an advertising medium as the newspaper, the billboard or the magazine. A sign, like the salesman or the editor, must talk to the people, who want to hear a new story, a new fact, as quickly as the eye and mind can grasp them. It is the talking sign which appeals to the public and sweeps aside all the old limitations. In order to understand more fully the functions of the sign about to be described, let us divide all electric signs into the following classes:

1. Non-changeable or fixed signs.
2. Signs in which the separate lamps or letters are turned on and off successively.
3. Signs which are lighted and extinguished at definite intervals.
4. Signs consisting of several rows of letters, which are successively turned on and off.
5. Signs combining two or more of the above features.
6. Signs on which each letter may be changed to any other letter of the alphabet, thus changing the entire sign at definite intervals; the signs being operated by a constant attendant.
7. Signs identical with the last-named, with the exception that they are operated automatically.

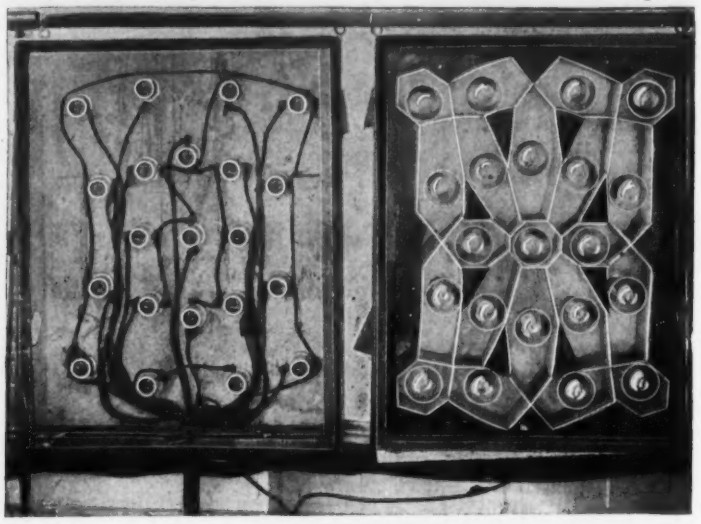


FIG. 3.—ONE OF THE MONOGRAMS.

It is upon this last named principle that the successful electric sign must be constructed, for it not only combines the advantages of an ordinary electric sign, but it enables one to tell a story of any number of words and sentences, as quickly as one wishes, automatically. And if all these conditions are realized in addition to the fact that the sign consumes only one-half of the current required for any fixed sign it seems as if the ideal has been reached.

Such a sign is in existence, and is located over the roofs of the two-story buildings at the northwest corner of Sixty-fifth Street

FIG. 2.—NIGHT VIEW ON BROADWAY, NEW YORK.

and Broadway, New York. This is one of the most prominent corners in the metropolis, as it is a transfer point for the surface cars, and is passed by all the Sixth and Ninth Avenue elevated trains. It is estimated that from 250,000 to 300,000 persons pass this point daily on cars alone. The sign is owned by the Mason Monogram Com-

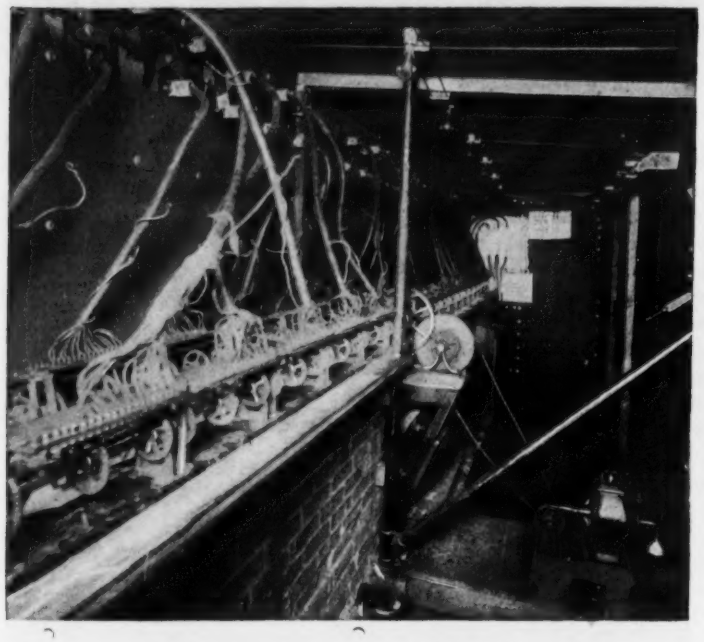


FIG. 4.—INSIDE OF OPERATING ROOM.

pany, of New York, who work under the patents granted to Mr. George L. Mason, Mr. Max Osterberg being the consulting engineer for the company. The sign, shown in Fig. 1, consists of two rows of boxes or "monograms," each row being 128 ft. in length. There are in all 48 monograms on the sign, each 3 ft. wide and 4 ft. high. The total length of the sign therefore is 256 ft. making this the largest electric sign in the world. It may be of interest to state that before this sign was erected the company constructed a single monogram on the Palisades 36 ft. in height, which could be plainly read all over the island of Manhattan and for some distance down the Bay.

Each monogram or box (shown in Fig. 3) consists of a number of tin boxes or troughs, united in such a manner that any letter of the alphabet or any number may be formed. Within each trough is an incandescent lamp—in this sign of 8 cp—and each trough is enameled white on the inside, the troughs thus acting as reflectors. It will be seen that a letter constructed on this principle will need a smaller number of lamps than an ordinary letter studded with lamps, and furthermore that the light is concentrated along certain sharp lines, obviating the blur which makes the ordinary sign so illegible at a distance; in fact, it appears as if these monogram letters can be distinguished twice as far as the old form of electric letter. There are 21 spaces or troughs to each monogram, and naturally the same number of lamps. The largest number of lamps used for the formation of any letter, however, is only 13, and the average number for any letter of the alphabet is 8. This is about half the number of lamps needed for the formation of the ordinary 4-foot letter, so that the cost of operating this sign is only one-half that of operating the

FIG. 6.—THE SIGN AT NIGHT.

old style. The sockets protrude through the bottom of the troughs and behind the plate supporting the troughs the wiring is hidden, as shown in Fig. 3. As the two lamps in the two bottom troughs are always used together they are wired on one circuit so that there are 20 circuits of one polarity leading from the box besides one common return for all the lamps, making a total of 21 wires. These are bunched together into a cable, as seen in Figs. 1 and 3, and are led down to the booth in which the commutators are located. As there

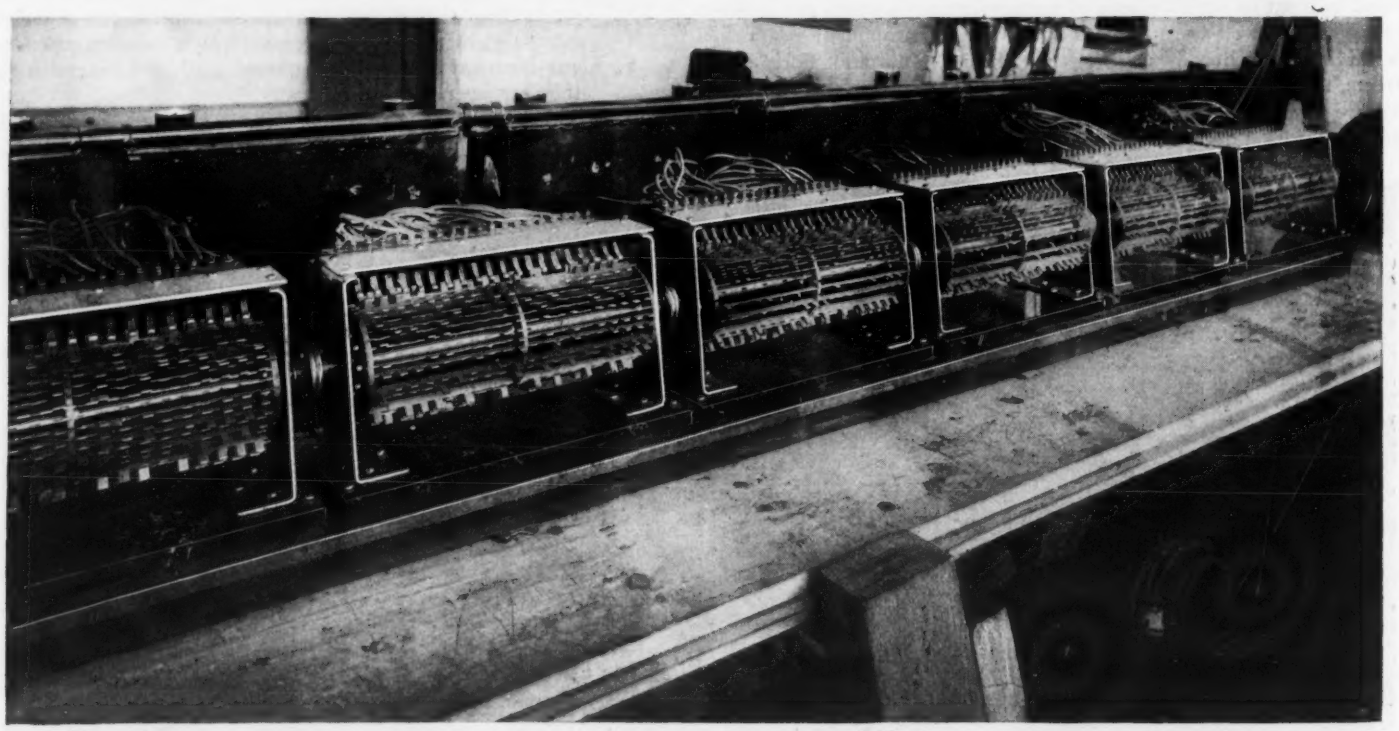


FIG. 5.—VIEW OF THE COMMUTATORS OF ELECTRIC SIGN.

are 48 monograms composing this sign, there are a total of $48 \times 21 = 1008$ wires.

Inside of this booth, shown partly in Fig. 4, are the two rows of commutators, one for each monogram, all connected by a shaft and separated from each other by means of an insulating coupling. The commutators, shown more plainly in Fig. 5, are each 14 inches in length, and consist of a revolving drum on the periphery of which,

and insulated therefrom, are mounted the copper selecting bars, each having as many projections as it is intended to light lamps in a monogram. Each bar takes care of the lamps in one monogram, and as in this sign it is the intention to have 40 changes on the sign for one complete revolution of the drum there are 40 bars on the periphery. Mounted above the drum is a plate which supports 20 springs or fingers, making contact with the projections left on the bars. To these 20 springs the 20 wires from the box are connected while the ones, representing other letters, and which are kept in stock. This common return is directly connected to one side of the main circuit, thus placing the commutators in series with the main feeders and monograms. If it be desired after the 40 changes have been prepared for all the monograms, to change a complete sentence, it is only necessary to take out one set of 48 bars and replace them by new ones, representing other letters, and which are kept in stock. This operation takes but little time, and can be accomplished without stopping the machinery.

The commutators are revolved by means of a ¼-hp motor, which, after its speed has been reduced by means of worm gearing is connected by belt to an intermittent gear having 40 teeth. This is of such a diameter and so adjusted that each time the one-tooth pinion enters its space on the gear the commutators are revolved so as to present a new sentence on the sign. It is so timed that the change is gradual, the sign never being in entire darkness, and a new sentence is shown every 10 seconds, 2 seconds of which may be said to be taken up by the gradual change.

Fig. 6 shows a night picture of the sign, which gives a good idea of the shape of the letters, which are legible as well as ornamental. While this sign is used for general advertising purposes, the company are making signs for individual users, who are enabled to talk to the public all the evening on any subject on which they may care to address them, changing the subject matter the next evening if they so desire. In conjunction with a keyboard, the sign may be used for announcement purposes, such as the signalling for carriages, or between ships, the results of contests and elections, and many other purposes. The colors of the monograms may be altered by affixing plates of colored glass in front of the boxes.

In view of the numerous advantages combined in such automatic changeable electric signs, they seem destined to open a new era in electric light advertising, and become an important factor in the business and electrical world.

Government Telegraphs and Telephones in England.

A critical review of the conditions of the telegraph and telephone in England is contributed to the latest issue of the *Nineteenth Century and After* by Prof. J. A. Fleming, who, in the fact of Government control or burdensome conditions imposed by legislation, finds an explanation for what he regard as the very backward state of electrical enterprise in England. His views are quoted in part below:

Now it is a curious coincidence that just at the dawn of this period of electrical activity—viz., in 1870—the Government of this country set themselves up in business as electricians, and proceeded to create a gigantic Government monopoly in one large department of electrical invention which has exercised a most undoubted control over the supply and demand for invention in a wide area of electrical work. Prior to 1870 the chief practical use which had been found for the electric current was in the electric telegraph. Public telegraphy was conducted by competing electric telegraph companies covering various areas of the country, just as the various railway companies do at present. Their development created a demand for electrical inventions in telegraphy, and the records of the Patent Office show how prolific were some inventors in supplying the need. The Government of that day thought it right in the public interest to buy up all these companies for a capital sum of £10,000,000, with the object of bringing the benefits of telegraphy within the reach of all. But in order to protect the capital thus invested from injury by competition, they passed acts of Parliaments in 1868 and 1869, giving the Post Office exclusive rights, with certain exceptions, to transmit messages and information by electricity when practiced for profit. When the telephone made its appearance in 1877, and telephone exchanges began to be devised in 1879, the question arose whether a telephone was a telegraph within the meaning of the act. The Government telegraph officials feared that their monopoly was threatened; hence with the assistance of the crown lawyers they proceeded to stake out a big claim, and to obtain an interpretation of the Telegraph acts, passed to legalize the purchase of the old electric telegraph companies, which was equivalent to an authoritative statement that the Post Office possessed the sole right to transmit intelligence by electrical means in return for payment, not merely as the art was then known, but by all and every method which the wit of man could or might throughout everlasting ages devise. Two judges, not the very strongest who have ever sat upon the bench, gave judgment in this sense against the United Telephone Company. Unfortunately the case never went to appeal, far less to the House of Lords. The victorious Post Office said to the vanquished telephone company, "Don't let us fight any more. Give us 10 per cent of your gross receipts and we will give you a license to work your invention."

The story of the relations of the Post Office and the telephone is a long one; some simple facts can only be mentioned here. The 10 per cent royalty paid by the National Telephone Company to the Post Office amounted in 1898-1899 to £123,061; in the past year probably to about £130,000. The proper telegraph business of the Post Office is conducted, as is well known, at a loss. * * * The total royalty paid by the National Telephone Company and its predecessors up to Sept. 30, 1900, has been £1,081,490. This has been a tax imposed by the Post Office on a new industry barely 20 years old. When the telephone first made its appearance the technical experts of the Post Office laughed at it as a toy. It was only when they were convinced of its utility by hard facts that they set in motion the legal machinery which enabled them to bring it within the grasp of the Telegraph acts. Yet the claim of the Post Office to finger this million of sovereigns depends only on a single decision in a Court of First Instance, and has never been confirmed by the higher legal tribunals.

The officials in the Government Telegraph Department were at once exalted into a position of paramount power over all electrical invention in land telegraphy. It is pure waste of time for an inventor to spend days and nights over a telegraphic invention, or invest capital in patenting it, unless he can get it tried, and if it succeeds, market his invention to a purchaser. He is not generally a philanthropist, but is spurred to work by the hope of reward. But in electric telegraphy he can try nothing and market nothing unless he first persuades or pleases the permanent officials of the State Telegraph Department. He has to overcome their inertia, opposition, or it may be ill will, before he can even get a trial of his telegraphic apparatus, and when at last he demonstrates an important advance, he is entirely at their mercy whether it shall be adopted or not, and, if so, what price he shall receive for it The permanent official in any Government department is not, as a rule, eager to introduce improvements from outside. He loves his departmental routine, his habits of mind are slow, methodical, cautious, and he does not want radical reforms. If there is to be any invention at all, he generally likes it to proceed from himself, doubtless at the expense of the nation, so that he may keep before the public eye, and convince his chiefs that he is a clever and important person. A young man bursting with new ideas does not generally enter the civil service, he prefers the greater freedom—if more risk—of a career outside; hence we should hardly expect a State telegraph official to be a prolific and original inventor The most effective method of afflicting any department of applied science with creeping paralysis is to constitute it a Government monopoly.

Prof. Fleming discusses the work of Marconi, and argues that the Post Office has been very inert; and "has continued to experiment deliberately with its own inductive system, a system which would be totally inapplicable to lightships and to very many lighthouses."

Protecting Railroads Against Burglars.

The Southside Alley Electric Elevated Road, Chicago, has put in a system of electric gongs to head off the men who have been robbing its stations. The ticket seller can, by a slight movement of foot or hand, spring the alarm by means of a projecting button of comfortable size, which is placed on a level with the seat of his high chair. Instantly a huge gong on the station platform outside the ticket office is set to thundering, and the sound, it is said, will penetrate the air for a distance of nearly a mile. At the same time, and by the same motion of foot or hand, similar gongs in every station will be set off, the nearest police station notified, private detectives summoned, and any persons who may be on the streets will be told to look out for fleeing burglars. "Our system," the company officials explain, "is not protected by patents, but it will not be duplicated readily. From the tests we have made it seems absolutely certain that any further attempts to burglarize our stations or to 'hold-up' the ticket sellers will fall short of successful execution."

Electricity in Switzerland.

BY H. L. GEISSEL.

ELECTRICITY is making, like all other industries, steady progress in Switzerland. During the last five years especially a considerable number of electrical enterprises have sprang up, either in the form of individual undertakings, or as joint stock companies. The latter predominate, and were formed, not so much for the purpose of engaging in the manufacture of electrical machinery and appliances, as with the object of developing electricity in general. Thus it comes that we find to-day the headquarters, or at least the financial headquarters, of many a Spanish, French, Italian and Russian electrical company in Switzerland. On the other hand, the manufacture of electrical machinery within the country is assuming larger proportions every year, which is best evidenced by the increasing exports and decreasing imports of electric machinery. In 1899 the exports of electrical machinery from Switzerland amounted in value to 12,257,081 francs, as against 8,941,211 francs in 1898. Swiss-made electrical machinery has always enjoyed a high name. Firms like Escher, Wyss & Co., the Oerlikon Company, Brown, Boveri & Co., etc., ship their machines and turbines to all parts of the world. In 1899 the exports were divided up as follows: To Russia, 2,769,754 francs; Germany, 1,928,874; France, 1,860,414; Scandinavia, 1,099,494; Spain, 827,771; Austria, 722,641; Great Britain, 522,167; Belgium, 494,048; East Africa, 115,575; Egypt, 81,235; Central America, 79,340; Netherlands, 68,862; Brazil, 53,000; Colombia 42,400; Balkan States, 34,485; United States, 19,000; West Africa, 8,300; Portugal, 8,000; Dutch East Indies, 2,800; Algeria, 2,790; Argentina, 2,070; Chili, 1,920; Greece, 1,200.

The imports of electrical machinery into Switzerland amounted only to 650,720 francs, as compared with 847,475 francs in 1898. Germany supplied 509,250 francs worth, whilst 56,165 francs worth came from France, and some quantities from Italy, Austria and the United States, our share having amounted in value to 22,090 francs.

A short review of the Swiss electrical joint stock companies, having a capital of more than 2,000,000 francs (about $386,000), will doubtless be of interest, as it gives a clearer idea of the important position which Switzerland occupies both as regards the manufacture of electrical appliances and the control of electrical companies. The Société Franco-Suisse Pour L'Industrie Eléctrique, in Geneva, is the largest electrical enterprise in Switzerland. The company, though only formed in July, 1898, is interested in a large number of prominent foreign undertakings. The company is more of a financial than of an industrial character, as it chiefly promotes electrical enterprises at home and abroad. The capital amounts to 25,000,000 francs, divided into 50,000 shares of 500 francs each. So far, 50 per cent of the nominal capital have been paid up. During the first year of its operation the company yielded 660,431 francs profits. The company is especially interested in the following electrical enterprises: St. Petersburg Tramways, Grenoble (France) Electric Light & Power Company, Paris; Neuilly Electric Company, Neuilly, France; St. Gervais (France) Electric Company, Twer (Russia) Tramways & Electric Power Company, Southern Electrical Company, of Naples (Italy); The Volta Electrochemical Company, of Rome (Italy), and the Russian Syndicate for Electrical Enterprises in Russia. Mr. James Odier, in Geneva, is president of the company.

The Rheinfelden Power Transmission Plant is partly a German, partly a Swiss undertaking. In 1898 the Baden Government granted a concession to the company for the purpose of utilizing the water powers of the Rhine near Rheinfelden for industrial purposes, and at the same time the administration of the Canton of Aargau in Switzerland, granted a similar concession. The nominal capital of the company is 6,000,000 marks, and up to the end of the year 1899 the amount of 4,500,000 marks had been paid up. So far, some 9,000,000 marks have been expended for the construction of the central power plant, hydraulic works and transformers at Rheinfelden. State Councillor Dr. Emil Frey, of Rheinfelden, is president of the company.

The Alioth Electrical Company, of Arlesheim, near Basle, was founded in 1895, with a capital of 6,000,000 francs, which, since Feb. 28, 1900, has been entirely paid up. The company is chiefly interested in the manufacture of electrical machinery and appliances, and has extensive workshops at Minchestein (Switzerland) and Lyons (France), in which some 800 operatives are employed. The dividends paid by the company amounted to 6 per cent in 1897 and 1898, and to 7 per cent in 1899.

The Motor Company, of Baden, founded in 1895, has a nominal capital of 6,000,000 francs, of which 3,000,000 francs have been paid so far. This company is especially interested in all lines of electrotechnical and electrochemical enterprises. The company owns and operates the electrical power plants of Grindelwald, Kander, Beznau (Switzerland), and that at Bingen (Germany), and is financially interested in various Swiss, Italian and German electrical companies. The dividends paid so far were 5 per cent in 1896, 5 per cent in 1897, 6 per cent in 1898 and 7 per cent in 1899. The well-known electrical firm of Brown, Boveri & Co., of Baden, Switzerland, is largely interested in this company.

The Hageneck Electrical Company, of Biel, was founded in 1898, with a nominal capital of 2,500,000 francs, divided into 5000 shares of 500 francs each. The company erected during the years 1898-1899 a large electric power plant on the Aare River near Hageneck, for industrial and lighting purposes.

The Company for Electrical Enterprises in Geneva was formed in 1895, with a capital of 2,000,000 francs, divided into 500 shares. So far 50 per cent of the capital has been paid. The company is interested in the central power plants of Belluno and Feltre (in the province of Venice, Italy); the Electric Light Works, of Faenza (Province of Ravenna, Italy); the Belgian Electric Light Company; the Electrical Works of Monte Albano (Italy); the Franco-Italian Industrial Company; the French Tudor Accumulator Company, and in several Spanish and other foreign electrical enterprises.

The well-known Oerlikon Company, of Zurich, has a capital of 6,000,000 francs, and paid a dividend of 10 per cent in 1899. Escher, Wyss & Co., of Zurich, also a stock company, have a capital of 5,000,000 francs, and paid a dividend of 6 per cent in 1899. The firm owns and operates the famous works at Zurich and Ravensburg.

Electrolytic Production of Phosphorus.

THE production of phosphorus by electrolytic means has been the subject of experiments by Dr. F. J. Machalske in his laboratory at Long Island City, N. Y., and it is stated that such satisfactory results have been obtained from the process developed from these experiments that a company, called the Anglo-American Chemical Company, has been formed to produce yellow and red phosphorus on a commercial scale. The following details of the system have been supplied by the inventor:

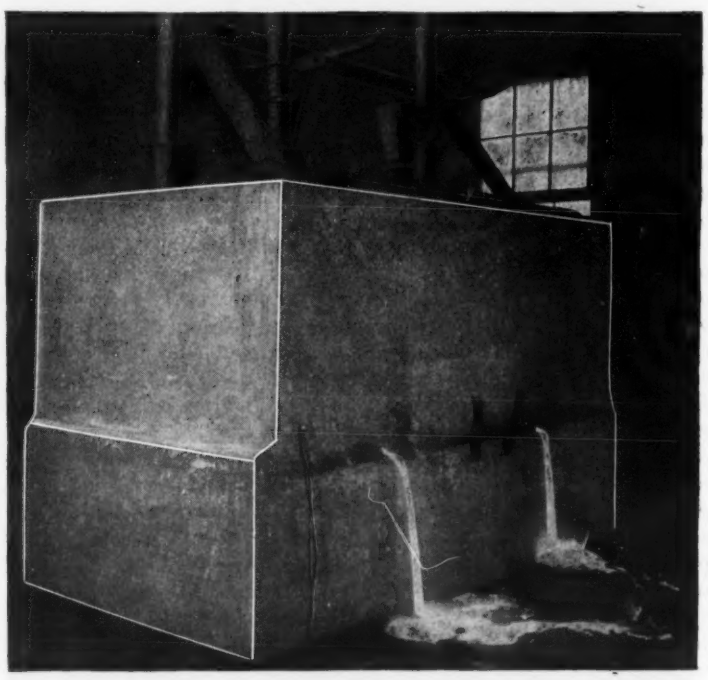


FIG. 1.—VIEW OF FURNACE.

The raw material consists of the ordinary phosphate rock used generally as a fertilizer. At present two electrical furnaces are installed, as illustrated in Figs. 1 and 3. The furnace is shown in section in Fig. 2. Each furnace has a chamber 12 ins. by 18 ins. in area with a carbon bottom and sides lined with calcined magnesia, the cover being composed of fire clay and red brick. Each furnace has an aperture on top for feeding the phosphate rock, and an aperture for inserting an electrode 8 ft. long and 4 ins. in diameter. It is

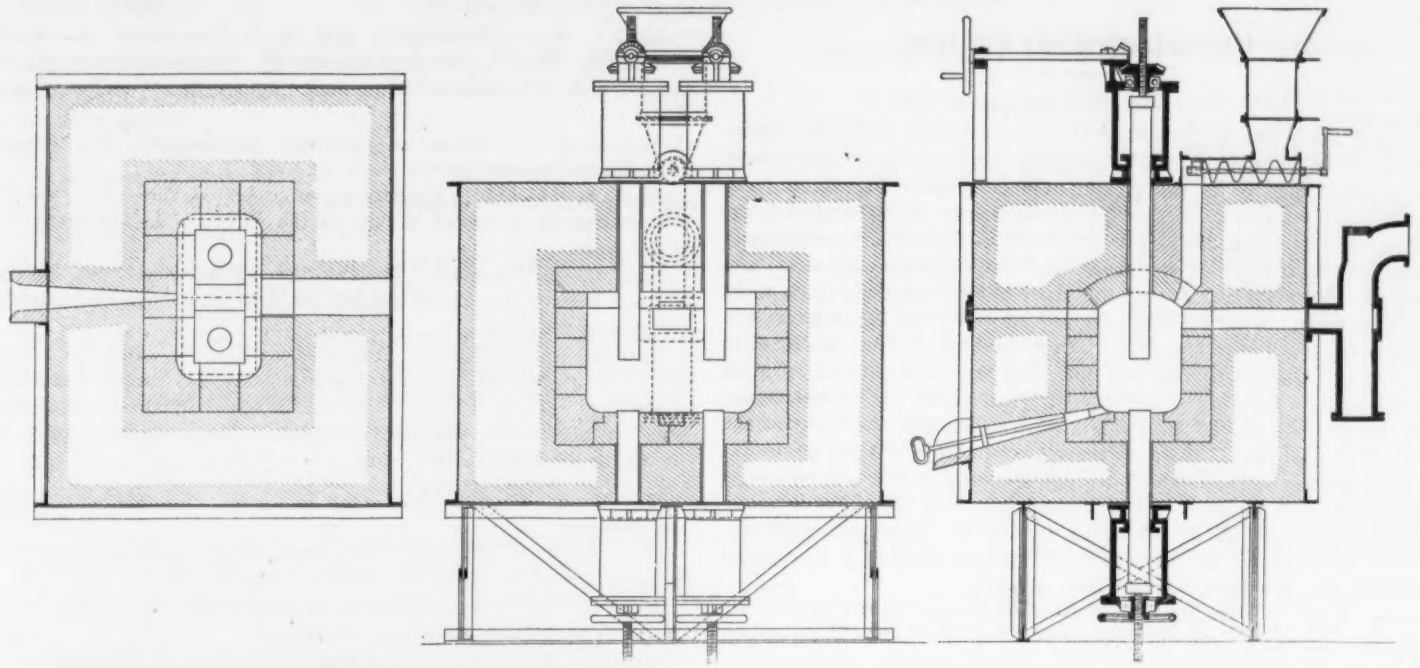


FIG. 2.—DETAILS OF ELECTRIC FURNACE FOR PHOSPHORUS PRODUCTION.

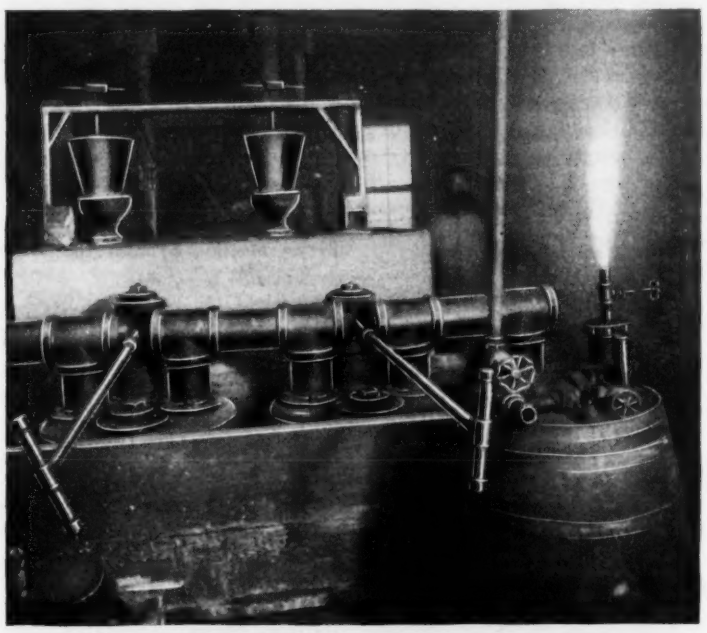


FIG. 3.—FURNACE, SHOWING ELECTRODES, FEEDERS AND CONDENSERS.

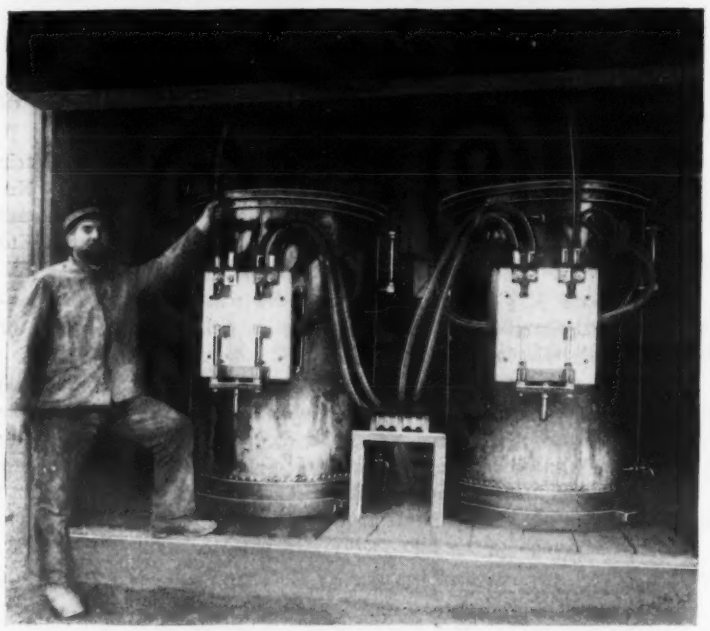


FIG. 4.—TRANSFORMERS FOR PHOSPHORUS PRODUCTION.

stated that five minutes after current is turned on a temperature of 7000 degs. F. is produced, which will reduce in 15 minutes 150 lbs. of phosphate rock. The phosphorus vapors set free are condensed under water and the residual slag allowed to run off, as shown in Fig. 1. The operation is a continuous one.

In Fig. 3 a double electric furnace is shown in the background with its feeding hoppers and carbon electrodes. Fig. 4 shows the two large Wagner transformers used with the reduction plant, each transformer being of 2000-amperes capacity. Current for the plant is furnished from the circuits of the New York & Queens Electric & Power Company, of Long Island City. It is claimed that yellow phosphorus may be produced by this method at a rate of 7 cents per lb., the cost of electric power being 3 cents per horse-power-hour.

Dr. Machalske claims to have separated by means of the electric furnaces a new metallic compound which has the appearance of silver, and is not affected by sulphuric or hydrochloric acid, though slightly attackable by concentrated nitric acid. The metal has a specific gravity of 10.02, and is a good conductor of electricity at common temperatures, but a non-conductor at temperatures at 100 degs. and above.* He also claims that in the course of his experiments he found that by means of an electrical furnace connected with a properly constructed condensing apparatus chlorides of carbon and especially carbon tetrachloride may be produced by treating in an electric furnace a mixture of common salt, carbon and sand.

Underground Roads in London.

The Baker Street & Waterloo Railway Company which it was supposed had been sold by the London Globe Financial Corporation weeks ago to Tom L. Johnson, of Cleveland, Ohio, appears to be still doing business under the old directorate. Its latest achievement is to purchase the booking offices of the London & Northwestern Company at Oxford circus for a station. In a few days the process of demolition of the buildings will begin before a shaft is sunk to connect with the tunnel. This tunnel has already pierced as far as the end of Regent Street and under the river to Waterloo Station. At Oxford circus connection will be made with the Central London tube, on the north side of Oxford Street. This will complete the triangular route between Oxford circus, the Bank and Waterloo.

It is expected to be fully 12 months before the road is ready to run trains. The company in the meantime is calling in an additional £2 ($10) a share to continue the operations.

Mr. Benjamin F. Cable, of Illinois, who has been in London for several weeks negotiating for the purchase of the road on behalf of the Johnson syndicate, left for Paris last night. His presence in England is regarded as certain proof that the deal is not yet consummated.

* A test of the so-called new metal does not bear out these claims.—EDS.

Patent Expirations for 1901.

By Wm. A. Rosenbaum.

Some years ago the *Electrical World* for a time published weekly a list of the contemporaneously expiring electrical patents, but owing to the fact that by far the greater number of patents granted never become of interest to the public, it was found that a large amount of space was being devoted to a subject which did not particularly concern the readers of the paper, and the publication of such lists ceased. Nevertheless, among the many patents expiring from week to week there are some which have proved useful and are of interest to those concerned with electrical affairs; therefore I have attempted to give below the identifying data and hints as to subject and scope of those patents expiring in the current year which, by current report or the writer's special knowledge, have to an extent controlled the electrical business. Doubtless there are some important patents expiring during the year which are not included in this list, but those given are of importance, and no attempt has been made to accurately discriminate. In all probability a number of the patents cited expired several years ago by reason of the expiration of prior foreign patents, but this point has not been investigated.

Jan. 1.—C. S. Bradley. System of Electrical Distribution. No. 291,141. Feeding different points of the system from independent sources and regulating sources independently of each other.

Jan. 1.—Charles McIntire. Wire Joint. No. 291,211. A double socket with openings for solder.

Jan. 8.—C. J. Vandepoele. Current Regulator for Electric Motors. No. 291,650. Centrifugal governor adapted to bring a larger or smaller number of the field sections into operation.

Jan. 15.—J. Wenstrom. Dynamo-Electric Machine. No. 292,079. Iron clad field; tunneled armature.

Jan. 29.—E. Weston. Electric Circuit. No. 292,718. Metallic circuit, partially overhead and partially in conduits; latter provided with junction boxes.

Jan. 29.—E. Weston. Fusible Safety Strip for Electric Circuits. No. 292,713. Strips having protecting ends of harder metal.

Jan. 29.—E. Weston. Electrical Indicator. No. 292,714. Armature with curved ends turning between curved polar faces, retractile spring and indicator arm.

Feb. 5.—E. T. Gilliland. Driving Gear for Magneto-Electric Machine. No. 293,160. Rotation of the driving crank automatically closes the circuit from armature to line.

Feb. 12.—J. Bergmann. Socket for Electric Lamps. No. 293,552. Shade holder detachably connected to lamp socket.

Feb. 26.—V. Himmer. Electric Device for Synchronizing Clock Pendulums. No. 294,132.

Feb. 26.—W. Hochhausen. Double Electric Arc Lamp. No. 294,042. Means for tripping the second mechanism when the first has acted to its limit.

Feb. 26.—F. L. Pope. Electrical Conductor. No. 294,148. Steel core coated with copper.

Feb. 26.—A. G. Waterhouse. Regulator for Dynamo-Electric Machines. No. 294,169. Regulation by shifting the poles of the field magnet.

Feb. 26.—E. Thomson. Dynamo-Electric Machine. No. 294,094. Axis of field magnet and armature in line, one pole of the field magnet being formed in the base of the machine and the other extending directly from the core of the field coil.

March 4.—F. M. Lytle and J. A. McCoy. Telephone Central Office Apparatus. No. 294,482. Switches arranged to connect subscribers' cords with either of two signaling keys.

March 4.—Z. T. Gramme. Commutator for Dynamo. No. 294,613. Brushes mounted on a single carrier and adjustable together.

March 4.—L. Stieringer. Combined Gas and Electric Fixture. No. 294,697. Wires covered by the ornamental portion of the fixture.

March 11.—Profs. Ayrton and Perry. Telpherage System. Electric motor traveling on a cable and pulling a load behind it.

March 11.—R. C. Stone. Telegraph Wire Supporter. No. 295,073. Copper wire suspended from steel wire, split insulators surrounding each.

March 18.—J. Absterdam. Automatic Telegraph. No. 295,219. Stylus traverses drum in which characters are set with non-conducting material.

March 25.—E. Thomson. Double Carbon Arc Lamp. No. 295,836. Shifting mechanism.

April 1.—C. L. Buckingham and H. C. Townsend. Automatic Cut-Out for Electric Lamps. No. 296,125. Lamps in series. Shunt around each. Secondary circuit including magnets for closing each shunt.

April 8.—J. A. Maloney. Telephone Transmitter. No. 296,421. Iron filings between carbon electrodes.

April 8.—H. Flad. Electromagnetic Air Brake. No. 296,546. Electromagnets arranged to operate the valves in an automatic air-brake system.

April 15.—E. Thomson. Dynamo-Electric Machine. No. 296,799. Storage battery in a shunt around the field magnet to maintain the polarity of the field.

April 29.—T. A. Edison. Incandescent Electric Lamp. No. 297,581. The globe contains a residual atmosphere of carbon monoxide.

April 29.—T. A. Edison. Dynamo-Electric Machine. No. 297,583. A belt-driven machine having endwise movement provided for the armature.

May 6.—E. Weston. Incandescent Lamp. No. 298,325. A zig-zag filament.

May 13.—T. B. Doolittle. Telephone Exchange Apparatus. No. 298,559.

May 13.—C. J. Van Depoele. Dynamotor. No. 298,431. An armature with two independent windings.

May 20.—H. E. Waite. Telephone Transmitter. No. 298,923.

May 20.—T. A. Edison. Mode of Operating Dynamo-Electric Machines. No. 298,956. Dynamos of different capacity connected in multiple with the same circuit, and means for regulating their electromotive force.

May 20.—R. P. Sellon. Apparatus for Charging Secondary Batteries. No. 299,021. An engine, dynamo and battery with mechanism for coupling and uncoupling the engine and dynamo according as the battery is charging or discharging.

May 27.—E. Jones and A. E. Jones. Electric Arc Lamp. No. 299,397. Current shunted around lamp if carbons break.

June 3.—H. B. Lytle and J. J. Carty. Method of and Apparatus for Individualizing Telephone Time Signals. No. 299,561.

June 3.—W. J. McCausland. Printing Telegraph. No. 299,664.

June 10.—E. W. Hazazer. Electric Bell. No. 300,263. Box in one piece, closed front, open back. Box forms back yoke of magnet.

June 17.—C. L. Buckingham and W. B. Vansize. Printing Telegraph. No. 300,341.

June 24.—F. W. Jones. Static Compensator for Telegraphs. No. 300,781.

June 24.—Wellington Adams. Electric Motor. No. 300,827. An annular field magnet forms the rim of a car wheel.

June 24.—W. S. Johnson. Electric Valve for Regulating Temperature. No. 301,059. For application in steam and water heating.

July 1.—A. W. Hall. Electric Railway Signal Apparatus. No. 301,361. Circuits normally closed and signals at safety. Train breaks circuit and de-energizes a magnet, which locks, when energized, the armature of another magnet in position to close a circuit controlling spring in the signal circuit.

July 8.—W. A. Jackson and W. R. Cole. Telephone System. No. 301,603. Test bars and talking bars arranged on opposite sides of a series of line plates.

July 8.—C. L. Clarke. Transmitting Device for Primary Electric Clocks and Means for Actuating Secondary Clocks Thereby. No. 301,805. A revolving-circuit closing point and a revolving-contact point against which said circuit closer is periodically caused to impinge.

July 22.—H. K. Goodwin. Telephone Switch. No. 302,330. Connecting cord containing switch to connect in either calling generator or operator's telephone.

July 22.—F. W. Jones. Quadruplex Telegraph. No. 302,410. Two transmitters, a main battery grounded at its middle through the back contacts of the transmitters, and connected at its terminals to the front contacts of same, a normally closed connection from line to earth through a resistance equal to that of the whole battery, and resistances in the two grounds from the middle of the battery equal to the resistances of the two sections of battery.

July 29.—E. T. Starr. Electric Motor. No. 302,793. The brush holder movable circumferentially and longitudinally relatively to the commutator.

Aug. 5.—E. Thomson. Focusing Arc Lamp. No. 302,961.

Aug. 12.—L. D. Hamilton. Double-Acting Relay for Electric Circuits. No. 303,570.

Aug. 19.—E. Thomson. Electric Arc Lamp. No. 303,762. Telescopic support for globe holder.

Aug. 26.—G. M. Phelps. Means for Rotating the Printing Wheels of Printing Telegraphs. No. 304,025.

Aug. 26.—T. A. Edison. Electrical Conductor. No. 304,087. Guard wires placed parallel and above conductor.

Sept. 9.—E. Weston. Electrical Recording Meter. No. 304,881.

Sept. 9.—E. Weston. System of Electric Lighting. No. 304,882. Series incandescent system with automatic lamp cut-out.

Sept. 9.—E. A. Sperry. Electric Arc Lamp. No. 304,966.

Sept. 9.—C. E. Scribner. Multiple Switchboard. No. 305,021. Normally open test circuits with means for connection while line is in use.

Sept. 16.—Fleeming Jenkin. Telpherage System. No. 305,194.

Sept. 23.—W. H. Knight. Electric Railway. No. 305,731. Sectional line, the sections being in series and cars on each section in parallel.

Sept. 30.—T. L. Dennis. Electric Arc Lamp. No. 306,005. Sectional adjustable magnet coil.

Oct. 7.—S. H. Bartlett. Telephone Switch. No. 306,050. A conducting cord having a switch contained therein.

Oct. 7.—C. G. Burke. Printing Telegraph. No. 306,055.

Oct. 7.—E. T. Gilliland. Telephone Circuit and Apparatus. No. 306,238. Trunk system.

Oct. 14.—M. G. Kellogg. Conducting Cord for Telephones. No. 396,495. Method of braiding double cords.

Oct. 14.—F. Van Rysselberghe. Combined Telegraphic and Telephonic Apparatus. No. 306,665. Arrangement of inductances and condensers whereby telegraphic and telephonic messages may be sent simultaneously over the same circuit.

Oct. 21.—Edward Weston. Process of Making Incandescent Lamp Filaments. No. 306,980. Building on a core by rendering incandescent in a carbon vapor.

Oct. 21.—A. A. Ripley and J. Bridgeford. Magnetic Ore Separator. No. 306,778.

Oct. 21.—W. Baxter, Jr. Enclosed Arc Light. Air Tight Arc Lamp. No. 306,998.

Nov. 4.—J. E. Smith. Electromagnetic Pole Changer. No. 307,498.

No. 11.—E. Thomson. Cut-Out for Electric Lamps. No. 307,819.

Nov. 11.—C. J. Vandepoele. Apparatus for Operating Tools by Electricity. No. 307,884. Reciprocating electric drill.

Nov. 11.—L. J. Phelps. Communicating to and from Moving Trains by Electricity. No. 307,484. Train telegraphy by induction.

Nov. 18.—M. G. Kellogg. Multiple Switchboard for Telephone Exchange. No. 308,315. A fundamental multiple switchboard patent.

Nov. 25.—C. H. Pond. Electro-Mechanical Clock. No. 308,521. Motor periodically set in motion to wind spring.

Dec. 2.—J. H. Vail. Electric Light Fixture. No. 308,712. Incandescent lamp and socket inside of globe.

Dec. 9.—F. J. Sprague. Adjustable Resistance for Electrical Circuits. No. 309,167.

Dec. 23.—W. K. Freeman. Regulator for Electric Generators and Motors. No. 309,536. Opposing coils connected to be thrown into series with field coils.

Dec. 23.—C. Selden. Means for Overcoming Static Disturbances in Telegraphy. 309,571. Auxiliary magnet in local current acts upon relay armature in opposition to relay magnet, simultaneously with flow of the discharge or return current.

Dec. 23.—E. Gray. Telephone Call Box. 309,617. Shunt around magnets held open during operation of calling.

Dec. 23.—John D. Lyle. Telephone Switch. No. 309,791. Detail of a hook switch.

Dec. 30.—J. H. Rogers. Telephone Transmitter. No. 310,151. Hinged electrode resting upon button.

Electrical Barge Canal for New York State.

A very important system of State canals, the boats to be run by electricity and to be 150 ft. long by 25 ft. wide, with a draft of 10 ft., and to travel in fleets, going from Albany to Buffalo in less than three days, is the plan presented by State Engineer Bond and a board of prominent engineers to Governor Odell. The system is to be built for $7,000,000 less than proposed by the Canal Commission appointed by Governor Roosevelt. The canals will be able to carry 15,000,000 tons of freight in a season of seven months. For building an Erie barge canal on the route favored by State Engineer Bond, $49,000,000; for deepening the Oswego Canal to 9 ft., $859,026; for deepening the Champlain Canal to 6 ft., $5,472,000; total cost of canal improvement, $55,331,026. These are figures, in round numbers, presented by State Engineer Bond to Governor Odell. They are figures that are surprising because it has been intimated that the figures of the Canal Commission of $62,000,000 would be far exceeded when a careful survey is made. The figures for the Erie Canal are $9,008,000 less than those of the Commission, while the figures for the Champlain Canal are three times the amount asked for by the Commission.

The estimate of $49,000,000 is for a canal of a size suitable for barges of 10 ft. draft, 25 ft. width and 150 ft. length. The canal, as planned and estimated for by these routes, is first class in every respect, with locks of the most modern type, capable of passing two boats at once, with recent improvements and methods for filling and emptying the locks, with power generated to pull the boats into and out of the locks, operate the gates and valves and furnish electric light. In the river and lake channels the minimum width is 200 ft. Both the bottom and sides of the canal are to be thoroughly puddled. Guard locks are provided wherever required, and in the canal sections guard gates are provided at distances apart not exceeding 10 miles, so that any section can be shut off for repairs. A full complement of first-class new bridges is provided wherever required.

In the navigation of the proposed canals only steam, electric or other mechanical motors have been considered, consequently the towing path will be a thing of the past. The estimate covers the marking of the channels of the canalized rivers by spar buoys, anchored to the bottom of the river and easily distinguished. Each lock is equipped with four arc lights on the lock proper and one on each approach. Besides these, incandescent lighting will be furnished for the lock houses. A large expenditure for water supply, not contemplated by the Canal Committee, has also been provided for in the estimate. This question of water supply is a very important one, and in making the plans provision is made for safety and surety, and at all times, in the dryest season, passing 10,000,000 tons of freight a year and at the same time fully conserving all existing water power and protecting corporate and municipal interests.

Water Power Development in Minnesota

The Highland Canal & Power Company, of Duluth, Minn, proposes to construct in St. Louis and Lake counties, Minn., a water power canal able to deliver to consumers 100,000 24-hour electrical horsepower. The water shed covers an area of more than 2500 square miles, taking but a proportion of the annual storm flow, and impounding it in reservoirs, while the nature of the ground and the extent of swamps, lakes and streams to be crossed makes particularly easy the 100,000 horse-power that can be uniformly maintained through a far longer period of drought than has ever been known in the region. The open canal brings water to a point within the city limits of Duluth, and some 776 ft. above the level of Lake Superior. The drop will be through a series of steel pipes to the power house located in the center of the manufacturing district along the Duluth-Superior harbor. It is stated that nowhere else in this country can power be generated and sold so cheaply, on account of favorable conditions for ease and cheapness of construction, maintenance and operation, with an abundant and reliable supply of water, an available fall of 776 ft. and short-distance transmission. It is expected by the projectors of this company that they will sell power on a graduated scale much like that of the Cataract Construction Company, and at about two-thirds the price charged by that company. The estimates show that the cost of the entire system of canal and installation of plant will be not greatly in excess of the cost of the tail race of the Cataract Co. at Niagara Falls. The chief promoter of the enterprise is Mr. F. A. Cokefair, a New York engineer. Mr. T. J. Fanning, of Minneapolis, has passed on the estimates.

Annual Report of the Westinghouse Company.

The annual report of the Westinghouse Electric & Manufacturing Company, says: On Dec. 31, 1900, the surplus balance amounted to $4,693,197, against $2,401,664 March 31, 1897, after having in the meantime from current earnings written off $2,786,719, and in addition there has been paid:

Interest on debenture certificates, collateral trust bonds, dividend script and other indebtedness	$891,293
Dividends on preferred stock	1,049,122
Dividends on assenting stock	605,512

The net shipments or sales have been as follows for the years ending March 31:

	1900.	1899.	1898.
Sales	$11,963,646	$6,901,760	$4,378,066

The figures for 1900 will be considerably exceeded during the fiscal year ending March 31, 1901.

President Westinghouse says: "It is believed that the foregoing record of progress will be satisfactory to all stockholders, and if some should be surprised that more complete statements have not been previously submitted to them, it can only be said that the directors, as well as the stockholders who own the largest amounts of stocks, have believed that in view of the existing keen competition and the general attitude toward industrial enterprises, the interests of all would be served by avoiding, to as great an extent as possible, giving undue publicity to the affairs of the company.

The greatly increased demand for electrical apparatus has necessitated large additions ot the works and machinery at East Pittsburg, with a corresponding increase in capital requirements. The company's interests abroad have also assumed large proportions, it having in addition to its ordinary shares in the British Westinghouse Electric & Manufacturing Company, Limited, a cash investment of $750,000 in the preferred shares of that company, besides a considerable sum in the company's other European business.

The rapid development in the use of electrical machinery warrants the belief that even the present large facilities of the company will be insufficient to meet the demands, and therefore it is the intention of the directors and managers to further increase the facilities of the company as rapidly as circumstances warrant.

Of the $3,500,000 of the company's debenture certificates $150.000 have already been retired and a further $150,000 have been purchased for retirement July 1, 1901. The annual charge of $150,000 for sinking fund or retiring purposes will be cared for by the earnings, without other provision in regard thereto.

To meet the already increased capital requirements of the company, which cannot be cared for from the earnings without hardship to the shareholders, $3,000,000 of assenting stock, sold at the best price obtainable, but not less than par, will suffice.

CURRENT NEWS AND NOTES.

HOLLAND TORPEDO BOATS.—A San Francisco correspondent informs us that the Union Iron Works in that city are making good progress on the construction of two Holland submarine boats for the United States Government, to cost about $170,000 each.

ELECTRIC LIGHT CONVENTION.—Secretary G. F. Porter, of the National Electric Light Association, informs us that the twenty-fourth annual convention will be held at Niagara Falls, N. Y., on May 21, 22 and 23, and that headquarters will be at the International Hotel, which opens early that month. The Pan-American Exposition at Buffalo will also be open.

STREET CAR FARES.—A bill has been jointly introduced at Albany by Senator Marshall and Assemblyman Wilson, providing that passengers in surface and elevated railroad cars in Brooklyn who are not provided with seats shall be carried and transferred for a fare of 2 cents, while from those who are seated 5 cents may be exacted. It would be interesting to see how such a law could be carried into practical effect.

WIRELESS OCEAN TELEGRAPHY.—A cable dispatch from London of Feb. 21 says: "Mr. James Galbraith, an agent of Mr. Nikola Tesla, left London to-day for Lisbon to establish a receiving station on the Portuguese coast at the fortieth parallel of latitude, which will be in communication with a Tesla transmitter located on the New Jersey coast." Reports from Boston assert that a station is being put up there for this end of the "line."

THE CANADIAN ELECTRICAL ASSOCIATION.—A meeting of the Executive Committee of the Canadian Electrical Association took place at Montreal on Feb. 12, at which arrangements were made for the annual convention to be held at Ottawa. It was decided that the dates of the convention should be June 19, 20 and 21. A committee was nominated to arrange for "Papers and Topics for Discussion," and also to make the necessary arrangement for the meeting which gives promise of being a most successful one in every respect.

EDISON STORAGE BATTERY.—For some time past it has been known to a few friends of Mr. Edison that he had effected important improvements on the storage battery, as to weight, endurance, etc., but the technical papers had been asked to allow the first publicity in the matter to come in the shape of a paper on the subject to be read by Dr. A. E. Kennelly before the American Institute of Electrical Engineers. On Sunday last the New York *Journal* printed a sensational article concerning this battery, containing, however, no information whatever as to its principles. In the course of the article a member of a firm of lawyers is quoted at length. We are informed by this gentleman that the remarks credited to him are a pure fabrication.

GOVERNOR WALLACE, OF INDIANA.—A "true" historical story of former Governor Wallace and Prof. Morse is being told to the effect that on Dec. 14, 1842, Morse appeared before the Committee on Appropriations of the United States Senate to ask for an appropriation to construct a line between Baltimore and Washington. After wrangling and bitter talk on squandering public funds, the committee announced that it had decided to give the "crank" a chance. The matter passed the Senate and went to the House. There the members had another hot fight. The matter was referred to the House Committee on Appropriations, and only through the deciding vote of David Wallace, of Indiana, afterward Governor, it was decided to grant the appropriation. Wallace returned home, but was badly defeated in his attempt to return to Congress on the ground that he had squandered the people's money by indorsing a visionary scheme.

ELECTRIC MARINE RAILWAY.—There has recently been installed, at Liverpool, Nova Scotia, an electric marine railway of a novel character. The equipment of this railway consists of a 30-hp induction motor, the motor shaft being geared to a heavy worm shaft and wheel; the worm wheel shaft carrying a pinion, which gears into another large wheel, on the shaft of which is placed a large, heavy sprocket wheel; over this sprocket wheel the heavy two-inch chain meshes into heavy sprocket teeth. This chain hauls the vessel upon a cradle over a track projecting out into the River Mersey to a distance of 500 ft. on a grade of ½-inch to the foot. The track and cradle are built of heavy pine timbers. It formerly took from four to five hours to haul up a vessel by the motive power hitherto supplied by horses, whereas the same work is now performed by electricity in 20 minutes. The present railway is the first one in America, and probably in the world, operated electrically.

ELECTRIC CONSOLIDATION IN MONTREAL.—An important option, involving several millions of dollars, is said in reliable Montreal financial circles, to have passed between the syndicate at the head of the proposed lighting and heating combine in Montreal and the majority of the shareholders of the Lachine Rapids Hydraulic & Land Company. This latter company is the only one outstanding which has not been reckoned with in connection with the establishment of the proposed combine, legislation for which is now pending before the Quebec Legislature. The Lachine directors have declared that they would not go into any amalgamation scheme, and it would have to be a straight buy-out, or nothing at all. They have accordingly been holding out for a big price, and it is claimed the figures represented in the option given to the combine people, for a short time, involve a handsome return to the Lachine company for the expense it has gone to in making the Lachine rapids a success.

THE CUP DEFENDER, it is stated from Bristol, R. I., will be an all-metal boat to be electrically riveted, welded, etc.

PNEUMATIC TUBE SYSTEM.—Postmaster Van Cott, of New York City, states that, as he understands it, the compromise appropriation of $225,000 agreed to by the Senate Committee on post offices and post roads would allow the continuance of the present pneumatic tube service in this city, but would provide for no extensions whatever. When the existing contract expires in July a new one will be made with the company operating the tubes, but, as the New York appropriation is greatly reduced by the compromise arrangement, they will have to accept a lower figure than in the past. This is considered by business men to be far better for the mails than the proposed discontinuance of the system.

MASSACHUSETTS ELECTRIC EXPRESS.—A bill has been filed by W. A. Twombly and others with the Massachusetts Legislature to incorporate the Massachusetts Electric Express Company. This company seeks authority for the making of contracts with electric lines to carry express matter and baggage. The Massachusetts Electric Express Company will furnish special cars, patterned after the mail cars now running over electric lines, paying the carrying company for service rendered on a mileage basis. A saving of 33 per cent is claimed for this method of express delivery over the present wagon delivery system. The various electric companies now have to petition for special legislation every time they desire to carry express matter. Under the present scheme much of this special legislation will be avoided.

HEATER FOR NERNST LAMPS.—In Nernst lamps it is usually undesirable to make the glowers of any very considerable length—that is to say, for higher voltage than, say, 220 volts. For voltage beyond this it is best to connect the glowers in series or multiple series, which arrangement, moreover, conduces to economy in manufacture and operation. A patent was issued Feb. 19 to Alexander J. Wurts for such an arrangement of glowers. In one form illustrated there are two groups in series, each group consisting of six glowers placed vertically. The two groups of six are separated by a porcelain plate and the heater wire is wound back and forth upon the sides of this plate and held in place by any suitable insulating enamel. The compensating resistances are in the forms of coils, each coil connecting a glower of one group in series with a glower of the other group on the opposite side of the plate.

LIMITING AUTOMOBILE SPEED.—The New York Assembly Committee on Internal Affairs has reported favorably S. W. Smith's bill giving a Board of Supervisors of any county authority to regulate the rate of speed of any vehicle ridden or driven on a public highway; also Mr. Doughty's bill giving that right to the Board of Supervisors of Nassau County. Both bills are aimed at automobiles. Mr. Doughty's bill is on the order of third reading in the House, having been recommitted for a hearing. The automobile advocates did not appear in opposition, but sent Mr. Smith a substitute bill. This regulated the speed of the automobiles much after the French law, an automobile being permitted to attain whatever speed the driver desired, but being compelled to slow down upon the approach of a driver of a horse, providing the driver holds up his hand to indicate that the auto is to slow down. Mr. Smith refused to accept the substitute bill.

SELECTIVE RELAY.—In automatic telephone exchanges the practice has been to employ two relays to close independent local circuits at the central station, including respectively a selecting magnet and a connecting magnet. To produce the intermittent current necessary for the exclusive operation of the lighter relay armature, a rhythmical circuit breaker at the sub-station is introduced into the main circuit, which also includes the central battery, and the requisite succession of current impulses is thus created. These in due season are followed by the establishment in the circuit of a steady current, and this is brought about when the sub-station telephone is removed from its switchhook, the circuit being thereby closed through the telephone, and the heavy relay armature is operated by the steady current. In a patent granted Feb. 19 to A. M. Bullard and L. A. Falk, a relay and circuit is described, the object of which is to provide a single relay capable of responding to either intermittent or continuous electric currents, and which under the influence of these currents is capable of selectively controlling either or both of two independent local circuits, for the operation of the apparatus associated with them. The relay has two independent armatures of different inertia; the heavier of these is irresponsive to interrupted or intermittent currents, but responds to the passage of a continuous or steady current. The lighter armature is arranged to be responsive either to a steady or to a rhythmically interrupted current.

LONDON'S NEW TELEPHONE SYSTEM.—The officials of the General Post Office expect that the new telephone system of London will begin operations in about six months, first in the city and the business district and later in the West End. Heretofore the conduits laid in the city and to the westward were sufficient to carry 60,000 miles of wire. Parliament voted £1,250,000, which is sufficient to cover a considerable area, but much more money will be required for general service throughout London. The National Telephone Company has heretofore held a monopoly of this business. This company has now decided to increase its stock by £1,000,000 in order to compete with the Post Office. A special dispatch of Feb. 23 from London says: Londoners have grown accustomed to the inconvenience of torn-up streets, which have been open so long that the bus drivers and cabmen have almost forgotten the short cuts across town, never knowing whether they can return by the same route between two points. Still, the chaos has not been without compensation in the number of historic relics turned up by the pickaxes of the workmen digging the telephone trenches. Not long ago at Charing Cross an old sewer pipe of the hollowed trunks of oak trees was unearthed. These were evidently of the pre-Roman period. This week the foundations of two towers, believed to be portions of the old London wall, were unearthed in Aldgate High Street. The gate between the towers is known to have been demolished in 1606, but the discovery of a lot of Roman coins, as well as of curious arches resembling the cloisters of an ancient abbey, gives the researches almost a Pompeiian character. Another piece of buried London has just seen daylight through the telephone trenches in the old burial ground of Farringdon Street, near the site of the old Fleet Prison. The young poet, Chatterton, is known to have been buried there after his suicide in Holborn.

A MARCONI PATENT.—A patent was issued Feb. 19 to Marconi on an improvement to his wireless telegraph system. A previous patent, described in these columns, provided for an arrangement whereby the aerial conductor, instead of being in direct connection with the coherer, is connected with one end of the primary of a transformer of which the other end is grounded, the secondary of the transformer being in the coherer circuit. According to the present patent this secondary is broken in the middle and the inner ends connected to the local battery circuit which includes the relay for working an ordinary telegraphic receiver, while the outer ends are connected direct to the coherer. It is stated to be advantageous also to place a condenser across the inner ends, in which case the local battery circuit is connected to the condenser. Details of one form of transformer are given as follows: The primary, which is in circuit with the aerial conductor, is wound on a core ¼ in. in diameter and consists of 100 turns of No. 27 copper wire insulated in single silk and coated with paraffin wax. The secondary is of No. 32 copper wire insulated with a single silk covering and wound over the primary, commencing in the middle and in the same sense as the primary. Each half of the secondary is wound with a decreasing number of layers, beginning with 77 in the first layer and ending with 3 in the seventeenth, making 500 turns in all. In another form described, the primary is wound on a core 1 in. in diameter and consists of 50 turns of No. 21 copper wire insulated with single silk covering. The secondary is of No. 40 copper wire insulated by a single silk covering and is wound over and in the same sense as the primary. Each half of the primary consists of 160 turns in a single layer. These coils are stated to give the best results when the length of the aerial conductor at each station is 150 ft. When using coils in which the secondary winding consists of one layer only, the best results have been attained when the length of the secondary winding is approximately equal to the length of the aerial conductor employed at the transmitting station.

HAWAIIAN CABLE.—An amendment to the Civil Appropriation bill now before the United States Senate authorizes a contract for building a Government cable from San Francisco to Hawaii and appropriates $500,000 for the purpose.

WIRELESS TELEGRAPHY ON SHIPBOARD.—A dispatch from London states that the British steamship Ophir, on which the Duke and Duchess of Cornwall and York will sail for Australia, is being fitted out with a system of wireless telegraphy.

MASSACHUSETTS STREET RAILWAYS earned gross in 1900 no less than $21,387,641, and net $8,227,694. The charges on this were $5,190,192, and the dividends $2,409,874, leaving a surplus of $627,628. The gross assets were $98,700,075, or nearly double what they were in 1893. There are 118 roads, and they carried 395,000,000 passengers.

A NOVEL BANK RUN was caused at Pittsburg, Pa., last week, by the visit of telephone linemen to the roof of the German National Bank, and their rapid movements caused some wag in the street to exclaim that there was a "run on the bank." The joke spread as a rumor and was soon converted into an ugly reality, causing heavy withdrawals.

A TROUBLESOME SPANISH MARRIAGE.—The recent marriage of the Princess of Asturias, of Spain, was so distasteful to some Spanish factions that it resulted in much popular disturbance. As a means of heading off a possible revolution the Government closed the telegraph and telephone service to the general public. A dispatch from Madrid a few days ago conveyed the intelligence that "the telephones are again working." They had been "busy."

COMBINED CIRCUIT BREAKER AND MOTOR STARTER.—A patent issued Feb. 12 to H. B. Cutter on an application dated Feb. 24, 1899, contains several claims covering the use of an automatic circuit breaker in series with an automatic motor starter. One of the claims is on the combination of a spring-actuated motor starter, electromagnetic means for normally restraining the same, and an automatic circuit breaker, the coil and switch of which carry the motor-actuating current.

SUGAR BY ELECTRICITY.—At the Congress of Applied Chemistry at the Paris Exposition, M. Dupont described a new sugar-making process wherein the juice of the beet or cane is placed in the middle compartment of a wooden vat fitted as an electrolyzer, and the albuminoidal matter of the juice is coagulated and precipitated under the action of the current. The salts are decomposed and the soluble bases separated. The sugar remains intact in the positive liquid. With a current of 15 volts, it takes an hour and a half to treat a solution containting 15 per cent of sugar.

ELECTRICAL NUT CRACKING.—It is stated that the industry of nut cracking gives employment to several thousand persons in St. Louis. Three plants have been established in that city. The output of the largest is some 1500 tons annually, representing 125 carloads of nuts. The work is done by machinery principally, electricity being the motive power. The process is slow, each nut having to be fed to the crusher by hand lengthwise. After the shell is cracked the nut falls into a receptacle, from which it is taken and winnowed by an air blast. The meat is picked from the crushed shells by hand, women and girls being employed in this work. The machinery employed in cracking nuts is expensive, it is said, and covered by patents. It is closely watched to prevent any invasion of the rights of the inventor, and access to the workroom is jealously guarded. The daily output of an electric machine is said to be 75 lbs. of nut meat.

ELECTRICITY AND THE PHYSICIAN.—Dr. John W. Coolidge, of Scranton, Pa., writes as follows to the newspaper named: "I have read with much interest and great profit the remarkable series of articles published in the *Sun* on "The Past Century, Its Progress in Great Subjects, etc.," the last of which, and the eighth in the series, is from the pen of Prof. Elihu Thomson and deals with the subject of electricity. Prof. Thomson says that 'electricity is finally to be one of the most potent agencies in the treatment of disease and the alleviation of human ills.' It is not fair to the medical profession that the lay reader of the *Sun* should draw his inference of the status of electricity in medicine to-day from the statements which I have quoted. While it was true that electricity for many years was used principally by those not trained in medicine, its use as a therapeutic agent has passed out of the hands of the 'quack' into those of the regular profession. The physics and the therapeutic application of electricity have advanced hand in hand in the foremost ranks of progressive medicine. I desire, with your permission, to amend the statement of Prof. Thomson that 'electricity is finally to be one of the most potent agencies in the alleviation of human suffering' by saying that electricity is to-day the most potent agent in medicine providing the doctor's skill controls its results. For with the same apparatus one physician may be a 'day laborer' and another an artist, and to recognize this distinction is the first step into the light."

LETTER TO THE EDITORS.

Automobile Driving Mechanism.

To the Editors of Electrical World and Engineer:

Sirs:—In automobiles the requirements are a vehicle which may be run by a lady or children in the city, which may be recharged at home in the suburbs, and which may be taken to the parks and the mountains, the vehicle being driven by a reciprocating engine or by an electric motor, or by both working together.

In the accompanying illustration, C represents a friction clutch pulley, which is connected to the armature shaft, C_1, represents another clutch pulley, which is connected to the engine driving

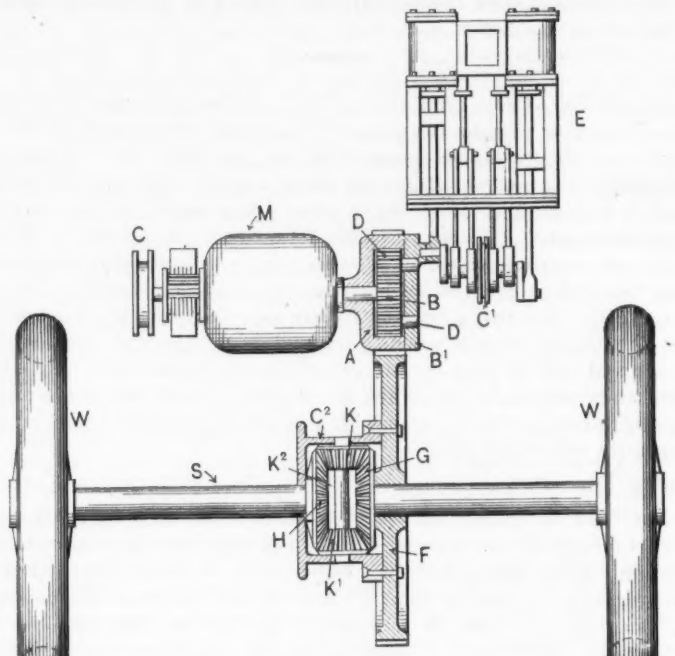


Fig. 1

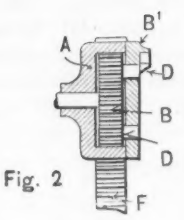


Fig. 2

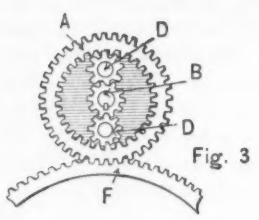


Fig. 3

FIGS. 1, 2 AND 3.—AUTOMOBILE DRIVING MECHANISM.

shaft, while C_2 represents a third clutch pulley, which is connected indirectly to the vehicle axle, which is used to brake the vehicle. If the clutch, C, is held, the armature remains stationary, while the engine transmits motion to the planetary gear pinions, D_1, driving the combined external and internal gear, A, and the vehicle to which the latter is connected. In this case the speed of the engine will be 250 r. p. m., while the vehicle wheels will be revolving at the rate of 100 r. p. m.; if the engine is held by the clutch, C_1, and the armature is free to rotate at a speed of 1000 per minute, the vehicle wheels will revolve at a reduction of 10 to 1, or at a speed of 100 per minute. If both the engine and the motor are allowed to revolve at those re-

spective speeds, no motion is transmitted to the vehicle axle. If, however, by independent regulation the motor is driven, for instance, faster or slower than its engine, the gear, *A*, turns differently. By varying the difference between the speeds of the separate powers the vehicle may be moved very slowly with a tremendous leverage, or very fast with a small leverage.

The motor is of the shunt-wound regenerative class, and ordinarily takes its current from the storage batteries carried on the vehicle. When it is desired to recharge the battery the vehicle is held by the clutch brake applied to the friction wheel, C_2, and the engine is then run, driving the motor as a dynamo, and recharging the storage battery. The voltage is controlled by the ordinary vehicle controller.

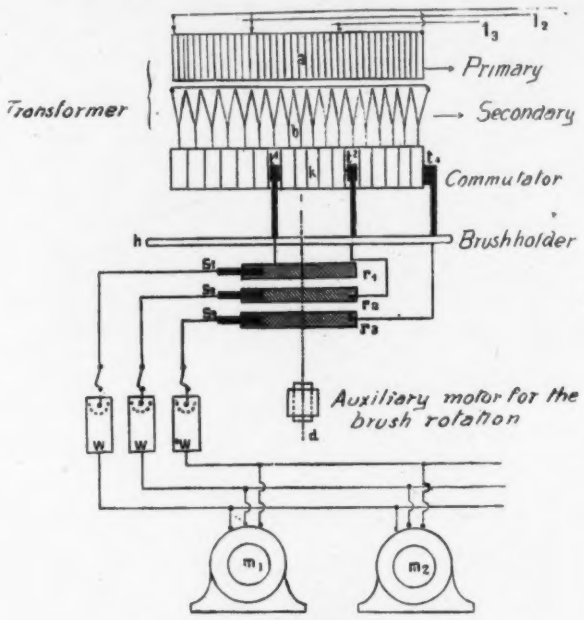
Instead of the steam engine shown, it is proposed to use a simple form of gas engine which would not require the ordinary starting machinery for igniters. JOHN. C. HENRY.

DENVER, COLO.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Starting Three-Phase Motors.—KREBS.—An article on a controller which may be used in a three-phase traction system, in which 12,000 volts, three-phase currents are transmitted and supplied to transformers on the cars, transformed down to 1000 volts and supplied to the three-phase motors. The arrangement suggested is shown in the adjoining diagram. *a* are the primaries, *b* the secondaries, of



STARTING THREE-PHASE MOTOR.

the transformer; the latter are, as in a continuous-current armature, connected to a commutator, *k*, on which three brushes, t_1 t_2 t_3, which form together angles of 120 degs. can rotate. The brushes are mounted on a disk, which is coupled with a three-part collector ring contact, r_1 r_2 r_3, the three brushes, t_1 t_2 t_3, being connected each with one of the slide rings, r_1 r_2 r_3. By means of a small auxiliary motor, *d*, the disk and the sliding rings can be revolved. The three slide rings are connected by means of the sliding contacts, S_1 S_2 S_3, with the motors, m_1 m_2. Rheostats may be inserted in these connections. Let the auxiliary motor be started so that the brushes revolve in the direction of the rotation of the rotary field. When the brushes revolve with synchronous speed, the motors rest; when the speed of rotation of the brushes decreases the motors run up until they have nearly synchronous speed, when the brushes rest. When the brushes rotate in a direction opposite to that of the rotary field, the speed of the motors is increased above synchronous speed. The motors are therefore started by decreasing the speed of the brushes from synchronous speed to zero. The motors are stopped by running the speed of the brushes up from zero. The brushes are not used when the motors are running at normal speed. They may then be disconnected.—*Elek. Rund.*, Feb. 1.

REFERENCE.

Modern Manufacture of Machines.—BOOTH.—An article on the methods of wholesale manufacture of electric machines, and on the machine tools and outfit used for this purpose.—Lond. *Elec. Rev.*, Feb. 8.

LIGHTS AND LIGHTING.

Osmium Filament for Incandescent Lamps.—A long abstract of a recent paper by Scholz on the new incandescent lamp with osmium filament invented by Auer von Welsbach. A source of light is the more economical the higher the temperature. A material which can stand well very high temperatures is osmium, which has the highest melting point of all metals. To use osmium for incandescent lamps, has become possible by an invention of Welsbach by which osmium wires can be made. An osmium wire is an electric conductor, so that the osmium filament is lighted directly in the same way by the current as an ordinary carbon filament. Experiments have shown that osmium lamps, which consumed 1.5 watt per candle had a long life, which was often 700 and sometimes 1000 or 1200 hours. One of these lamps, which consumed 1.45 watt per candle in the beginning, burned 1500 hours and consumed then 1.7 watt per candle. When osmium lamps become darkened by use, they can be brought back into a useful condition by a simple, inexpensive way, without renovation of the filament or globe. This regeneration can be repeated several times if the filament is intact. The process of regeneration is not described. Osmium lamps are made for pressures from 25 to 50 volts. In 100 to 220-volt installations several lamps must, therefore, be connected in series. After the paper had been read, demonstrations were made for the comparison of osmium lamps with ordinary incandescent lamp. It was shown that for the same candle power osmium lamps consumed only 40 per cent of the current of ordinary incandescent lamps at the same voltage, which means a saving of 60 per cent. When an osmium lamp and a carbon filament lamp consumed the same energy, the former gave 3½ times the number of candles of the latter.—*Zeit. fuer Beleucht.*, Jan. 30.

POWER

Transmission Plant in Sumatra.—An illustrated description of a water-driven three-phase power transmission plant, supplying current to the Redjang-Lebong gold mine of Sumatra. The power used is 66 hp for the stamps, including the rough crushing stamps, and separators for separating the coarse from the fine material coming from the stamps themselves; 37.5 hp for the extension of the stamping equipment; 37.5 hp for the compressor to produce compressed air for working the drills; 10 hp for the workshop; 10 hp for the pumps for the cyanide solution, and 10 hp for lighting. Two 37.5-motors and a number of smaller motors are used. The water-power plant is two miles from the mine, and contains three 100-kw generators, giving three-phase currents at 2200 volts. The smaller motors and lighting are provided for on low-pressure circuits through transformers, but some of the larger motors are supplied directly at 2000 volts.—Lond. *Elec.*, Feb. 8.

Electricity in Coal Mining.—MOUNTAIN.—A long, illustrated article, in which he first gives some examples in which the adoption of electrical machinery not only enables one to obtain a considerable economy in working, but also a good return on capital expended. He says that it is best in all cases to provide for the plant being of ample size, because if it works satisfactorily, it is generally found that extensions are quickly made. The best type of machinery should always be adopted. He briefly discusses the installation of the plant and the use of electric power for pumping, hauling and coal cutting. Regarding the choice of system, he says that direct-current working, particularly when the machinery is well designed and of large enough capacity, is very satisfactory, and "the only advantage which the advocates of the three-phase system can bring forward is that they have no commutators, but in the writer's opinion, this is a

somewhat misleading way of looking at it, as there is no reason why commutators should give any trouble if well designed and looked after." With a power plant at a great distance the three-phase transmission is preferable.—Lond. *Elec. Rev.*, Feb. 8.

Gas Engines for Central Stations.—HUMPHREY.—A reply to some critical remarks in the editorial noticed in the Digest, Feb. 16. He thinks that a hydrocarbon gas, supplied by existing town gas works, is far too valuable a product to consume in gas engines. Mond gas is much cheaper. He claims that the exhaust gases from stations with gas power, are of less volume and less obnoxious than from stations with steam power. He also says that the starting of large gas engines is now a matter of great simplicity. Compressed air is used for the purpose in the ordinary cylinder, and its action is quick and certain. These statements are again criticized in some editorial notes, where it is said that in spite of its many glaring elements of inferiority, the steam engine has a firm hold on the first place. A gas engine is essentially not a salf-starting engine, whereas a steam engine is. Even compressed air is not always satisfactory for starting gas engines. A 100,000-hp gas-driven station in a residential district is thought to be an intolerable nuisance, especially if the gas producer were to be annexed to the station.—Lond. *Elec.*, Feb. 8.

TRACTION.

Three-Wire System on a French Railway.—LEGRAND.—An illustrated description of the electric tramway from Grenoble to Chapareillan, where the three-wire system is used. The length of the line is 26 miles. The power house, where water power is utilized, is on the road, 7 miles from Grenoble. There are two turbine-driven direct-current dynamos, each giving 417 amp. at 600 volts. They are connected in series so that the free terminals have the potential + 600 and — 600 volts. There are three groups of two feeders, which supply the double overhead line, divided into three independent parts. The terminals of these parts being Grenoble, Les Drogeaux and Chapareillan. The voltage drop to Grenoble is 250 volts, that to Drogeaux is 150 volts, that to Chapareillan 225 volts. To compensate for this drop of voltage, for each feeder a booster is used, so that in the most unfavorable case the loss in the line is not more than 60 volts. The rails are the neutral in the three-wire system, while the two motors on each car are supplied with current from two overhead wires over the track, with two trolley poles. These two wires form the outers of the three-wire system. The motors are thus always connected in series at 1200 volts. (It seems, therefore, that it is merely a double trolley system with 1200 volts. The neutral circuit comes into action only when the two motors on the same car are unequally loaded. It can, therefore, hardly be termed a three-wire system, as usually understood.)—*L'Eclairage Elec.*, Jan. 26.

Rating Tramway Motors.—MUELLER.—An article in which he shows that it is not sufficient to characterize a tramway motor by its horse power. He advocates the following notation: A motor No. 100/15 is a motor which, during a certain time, without being heated over the temperature of the surroundings by 65 or 75 degs. C., yields a tractive force of 100 kg., giving to the car a speed of 15 kilometers per hour, a certain voltage and a certain wheel diameter being supposed. He recommends making experiments to determine the best value of the time upon which such rating should be based. This value depends, of course, largely upon the form of the discontinuous service to which the motor is put. He believes, however, that one hour, as assumed by American companies, is too small, and that two hours would be more correct.—*Elek. Zeit.*, Jan. 24.

REFERENCES.

Lewiston.—FAIRCHILD.—An illustrated description of the Lewistown, Brunswick & Bath St. R'y Company in Maine. The lines comprise 55 miles of track. Current is generated at both steam and water-power stations by double-current machines. The direct-current end gives current at 550 volts, while the alternating current is transformed up to 10,000 volts and transmitted to sub-stations—*St. R'y Rev.*, Feb.

Sioux City.—An illustrated description of the system of the Sioux City Traction Company, which comprises 41 miles of track. The trolley system is used. The power plant contains two 400-kw generators.—*St. R'y Rev.*, Feb.

Wannsee Railway.—BORK.—A long abstract of his paper on this German electric railway which has been mentioned repeatedly in the Digest.—Lond. *Elec. Eng.*, Feb. 8.

Polyphase Traction.—PERKINS.—Brief illustrated descriptions of polyphase electric locomotives, manufactured by Ganz & Co., as offered for the Metropolitan District Underground R'y, of London; the Oerlikon Company, as used on the Jungfrau Railway, and Brown & Boveri, as used on the Burgdorf-Thun R'y.—*West. Elec.*, Feb. 16.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Capacity in Alternating-Current Work.—DE HOOR.—A communication referring to the paper of Mordey, abstracted in the Digest, Feb. 9, 16. He first summarizes our present knowledge of dielectric hysteresis. "The dielectric constant of all those bodies in which the existence of an electrostatic hysteresis can be proven, varies with the polarizing e. m. f. At small e. m. f.'s, for instance, from zero to 30 volts cm, this variation can—on account of the disturbing influences of other phenomena—as a rule be examined only with great difficulty. However, there are types of dielectric bodies—eg, layers of plant fibre dielectrics, at which the experimental proof can be brought without difficulty at e. m. f.'s between 30-100,000 volts cm. Measurements executed with alternating e. m. f.'s alone cannot give a clear picture regarding the variation of the dielectric capacity with the e. m. f., and can be used only in combination with the results of static methods. The much-mentioned experimental fact that in a given dielectric the capacity current rises proportionally with the effective impressed e. m. f., is not a proof for the constancy of the dielectric capacity." There are cases in which the dielectric capacity varies, and yet the capacity current, calculated by means of the various values of dielectric capacity and the known curve of the e. m. f., and agreeing within large limits with the measured values, is proportional to the e. m. f. The separation of the electrostatic and viscous hysteresis work (the value of the latter is very low in the materials used for cables) by measuring the capacity currents at different periods, can easily be effected. The electrostatic hysteresis work increases at low e. m. f.'s nearly proportionally with the second power of the e. m. f.—at higher e. m. f.'s with the 1.7 to 1.6 power of the e. m. f. Referring to Mordey's experiments, he remarks that a power factor of 0.124, as found by Mordey, is an extraordinarily high one, and if there has been no mistake, it must be due to the cable having been made of a material of extremely high specific hysteresis. He gives numerical results of experiments made by him and others, which show that the cables generally used have a considerably lower power factor and hysteresis loss per unit of volume. In a network of 200 kilometers of 3000-volt cables, he finds that the electrostatic hysteresis loss will be only about 1.45 per cent of the total loss. Regarding the choking coils proposed by Mordey, he remarks that the motors and the not-fully-loaded transformers of a modern aletrnating-current plant, are the "natural chokers." He would like to call them, in the sense of Mordey, even "supernatural," as in consequence of their action the current always lags behind in modern central stations working for light and power, and the average power factor hardly surpasses 0.8, so that the electricians would rather be inclined to increase than to decrease the capacity. Even supposing that in consequence of the action of the capacity the current would be leading by 45 degs., he could not derive any technical difficulties from this circumstance. With regard to the efficiency and armature reaction of generators, he would decidedly prefer a current 45 degs. in advance to one 45 degs. lagging behind. The only technical difficulties in the use of great capacities are those arising from resonance phenomena, and those arising from the switching in or out of great cables, and the burning out of fuses, and these can be easily made harmless by the use of suitable and relatively cheap safety devices. (The author is consulting engineer with Ganz & Co., of Budapest.)—Lond. *Elec.*, Feb. 8.

Systems of Charging.—An anonymous communication, in which the Wright maximum demand system is first discussed. The writer says that the maximum demand indicator does not indicate in any way the number of hours a consumer has made use of the supply. He also claims that the maximum demand system of charging is most unfair to a customer who turns on all his lights for a quarter of an hour one day in a quarter of 91 days. He agrees, however, that the system improves the load factor of a station. He thinks that the Wright system of charging is on the right basis, but that the maximum demand indicator does not in any way assist the engineer to ascertain that which he wishes to know, i. e., the number of hours each consumer is in the habit of using the light. He recommends the following system: The indicator, which is a very simple piece of apparatus and is shortly to be put on the market, marks

directly on the scale the average number of hours per day a consumer uses above a certain percentage of his total capacity, which percentage can be varied by moving a set hand in the instrument. It is proposed to charge according to a basis like the following: One hour per day, 16 cents per unit; 2 hours, 14 cents; 3 hours, 12 cents, etc.; 7 hours, 6 cents, 10 hours, 5 cents.—*Lightning*, Jan. 31.

Quite a number of communications, by Tuckett, Ram, Steinmetz, Jones, Ingram and Root, on this subject. The general opinion is not favorable to the new system. The meagre description of the improved apparatus, mentioned in the anonymous letter, is criticized. Tuckett says that one valid objection to the Wright demand indicator is that it fails to record at what hour the maximum demand is made, i. e., whether it coincides with the peak. But this deficiency affects a very small proportion of the consumers, and can be provided for, if necessary, by means of a time switch. Moreover, the suggested new apparatus is equally subject to this objection. Where the higher maximum demand is quite abnormal and exceptional, the supply company is usually willing to short-circuit the indicator for the occasion. Where, however, the higher maximum demand is merely irregular—and this is the case in 90 per cent of the cases—the Wright system properly bases the charge on such maximum demand. Ram denies that the maximum demand indicator does not in any way assist the engineer to ascertain the number of hours each consumer is in the habit of using the light. A table showing half-yearly the average number of hours per day that each individual consumer uses his average maximum demand, can be made from the readings of the maximum demand indicator in conjunction with the readings of the meter.—*Lightning*, Feb. 7.

Glasgow Exhibition.—YOUNG.—A lecture on the engineering and and electric work of the Glasgow exhibition, 1901. Direct current will be used throughout. The plant contains 12 sets of combined steam engines and dynamos, with an aggregate output of 4200 hp. Five of the dynamos are working at a pressure of 500 to 530 volts, and seven at a pressure of 250 to 265 volts. The lighting is done by 10-ampere arc lamps of various types, and incandescent lamps of various powers. Many exhibitors will show machinery in motion driven by electric motors, ranging from ¼ to 150 hp.—Lond. *Elec. Rev.*, Feb. 8.

REFERENCES.

Automatic Cut-Out.—MUELLER.—A long illustrated description of his automatic cut-out, which was described in the Digest, Oct. 20.—Lond. *Elec.*, Feb. 8.

Lighting Plant.—An illustrated description of the power plant for lighting a twine mill in Chicago. There are three 250-volt, direct-current machines of together 280 kw.—*West. Elec.*, Feb. 16.

Motherwell.—An illustrated description of this new British direct-current plant. The capacity of the machines is 170 kw, there is also a battery giving 40 amperes for 5 hours.—Lond. *Elec. Eng.*, Feb. 8.

Russia.—BAKER.—The first part of an illustrated article on electrical work in Russia. He gives some historical data on electric lighting plants in St. Petersburg.—*Lightning*, Feb. 7.

WIRES, WIRING AND CONDUITS.

Joining Alumium Cables.—An article, in which it is said that by carefully cleaning and tinning the surfaces to be joined and using some one of a number of special alloys for the solder, joints are now made which in tensile strength and conductivity exceed the aluminum wire itself. Several solders for this purpose are successfully used the majority of them having as a basis pure in with a little phosphor tin added. The successful experiences of the Northwestern Elec. Rev. Company, of Chicago, the Am. R'y Company, of Philadelphia, and the Southern Ohio Traction Company, of Hamilton, are quoted, and the methods used by these companies for joining aluminum cables are described. The method of Herneus, which has been already described in the Digest, is also noticed.—*St. R'y Rev.*, Feb.

REFERENCES.

Insulating Varnish.—An article on the "Armacell" insulating varnish, made by a British company. Exceilent insulating properties and permanence at higher temperatures are claimed for it. Some results of tests made in the German Reichsanstalt are given.—Lond. *Elec. Eng.*, Feb. 8.

Three-Phase Transmission—STOJSAVLJEVIE.—An article, illustrated by diagrams and numerical examples, in which he shows how to calculate a high-tension three-phase transmission scheme.—*Zeit. f. Elek.*, Jan. 20, 27.

ELECTRO-PHYSICS AND MAGNETISM.

Influence of the Wave Form Upon the Iron Losses.—BENISCHKE.—An illustrated account of an experimental investigation. The results are summed up as follows: At varying magnetization the Steinmetz co-efficient depends not only upon the value of the magnetic induction, but also upon the wave form. It is the smaller, the more pointed the curve of the lines of induction is. The usual formula for calculating the iron losses as sum of the hysteresis and eddy current losses is only approximate. The approximation is the better, the smaller the eddy current losses. Nevertheless, the values of the Steinmetz co-efficient of hysteresis, found in this way, may be regarded as sufficient for estimating sorts of iron. He also gives a formula for calculating the co-efficient of the eddy current loss in sheet iron.—*Elek. Zeit.*, Jan. 17.

Discharge Through a Gas.—WILLOWS.—An account of experiments on the effect of a magnetic field on the discharge through a gas. At a pressure below 5 mm the effect of the magnetic field is to decrease the electric force near the cathode. This decrease depends on the strength of field and current used. At higher pressures the magnet increases the electric force. If the magnet causes the column to striate, it also causes the electric force to show periodic variations. The magnet generally causes the electric force at the anode to increase.—*Phil. Mag.*, Feb.

Positive and Negative Ions.—TOWNSEND.—A long paper on "The conductivity produced in gases by the motion of negatively charged ions." He produces experimental evidence to show that positive and negative ions have very different physical properties. For a large range of forces, the positive ions do not contribute to the generation of ions, but it is probable that positive ions may produce ionization in stronger fields.—*Phil. Mag.*, Feb.

Change of Magnetic Moment by Shocks.—KRUESE.—An account of experiments in which bar magnets were subjected to violent treatment and the resulting change of magnetic moment measured. The results are given in tables. Among other things, it is found, in bumping the magnets, that the greatest decrease is after the first fall, and that only in isolated cases does the moment remain unchanged after frequent falls from the same height. The total decrease of moment varies between 1.6 per cent and 25.6 per cent. The changes due to pulling the magnets from contact with a soft iron bar are very slight, being an increase after the first separation, changing to a decrease after 10 separations. Drawing a magnet off a soft iron plate sometimes diminishes the moment 28 per cent.—*Akad. Wiss. Wien. Sitz. Ber.*, Jan. to Mar., 1900; abstracted in *Science Abstracts*, Jan.

REFERENCES.

Refraction of Electric Waves.—PIERCE.—An illustrated account of measurements of indices of refraction of paraffine, hard rubber and woods for electric waves by means of a modified radio-micrometer.—*Phil. Mag.*, Feb.

Self-Inductance and Electric Inertia.—SCHUSTER.—His British Phys. Soc'y paper in full, an abstract of which was noticed in the Digest, Jan. 12.—*Phil. Mag.*, Feb.

ELECTRO-CHEMISTRY AND BATTERIES.

Internal Resistance of the Lead Accumulator.—DOLEZALEK and GAHL.—An account of an experimental investigation of the variation of the lead accumulator during the charge and discharge. This internal resistance is very small, and is some 10,000ths of an ohm in the cells used in practice. The resistance increases gradually during the discharge. It decreases during the charge. In spite of its small value, the internal resistance is greater than it ought to be if calculated from the conductivity of the electrolyte. It must, therefore, exist in certain transition resistance at the plates, due to films of non-conducting lead sulphate on the spongy lead and lead peroxide, or due to variations of concentration of the acid at the plates. The results of their investigation are given in diagrams. They find that in practice the increase of the resistance of the negative electrodes during discharge is entirely negligible. There is practically only an increase of resistance of the positive plate during discharge. But of greater importance in practice are the drop of voltage due to variations of the concentrations at the electrodes and to the resistance of the support of the active mass, especially of the

negative plates. In comparison to these essential factors, the real internal resistance, which consists of the resistance of the electrolyte and the transition resistance between acid and plate, is negligible. *Zeit. f. Elektrochemie,* Jan. 24, 31.

Nickel Plating.—PFANHAUSER.—While the production of satisfactory deposits of nickel from solutions of the sulphate or chloride salts of nickel and ammonia is comparatively simple, generally low-current densities had to be used, 0.3 to 0.4 ampere per square decimeter, so that considerable time was required. He claims to have invented a process which is much quicker, the current density being about 10 amperes per square decimeter. Only direct-current dynamos are used as sources of current. A layer of nickel of 1 mm thickness is obtained in 8 to 9 hours. A homogeneous and adherent deposit of nickel can be obtained in 2 to 3 minutes. It is thought that this will lead to a very extended use, especially in electrotyping and type-casting works, as copper or type metal faced with nickel will stand longer use than the unprotected metals.—*Metallarb.,* 1900, 25, 310; *Elektrochm. Zeit.,* Jan.

Some editorial remarks on this subject. Reference is made to a former investigation of Foerster. The above article is criticized for the lack of details concerning the improvements. It is thought that possibly the process depends for its success upon the use of some double salt of nickel which has hitherto been overlooked by practical electrochemists.—Lond. *Elec.,* Feb. 8.

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Electrolytic Process of Making Parabolic Reflectors.—An illustrated description of the Cowper-Coles electrolytic process for the manufacture of parabolic reflectors, as used by the Search Light Syndicate.—Lond. *Elec.,* Feb. 8.

Electrolytic Bleaching.—OETTEL.—A reply to the criticism of Engelhardt of his former paper, already noticed in the Digest.—*Zeit. f. Elektrochemie,* Jan. 31.

Electrolytic Analysis.—ARTH.—An account of some new investigations; by Ost and Klapproth on the estimation of antimony; by Kahlenberg, on solutions in a solvent other than water; by Paweck, on the use of cathodes of amalgamated brass.—*L'Eclairage Elec.,* Jan. 26.

Electrolytic Analyses.—HOLLAND.—A summary of the principles of electrolytic analysis. He first gives the laws for the minimum e. m. f. required to get a deposit of a metal from a salt solution, and the influence of the concentration upon this e. m. f. The current, the current density, and the electrodes are also discussed.—*Rev. Gen. des Sc.,* Jan. 30.

Autoxidation.—HABER.—A theoretical paper on "Autoxidation and its connection with the theory of the ions and of the galvanic cells." Autoxidation is such a process in which a body, liable to oxidation, has a tendency to react with water and oxygen of the air in such a way that it combines with two atoms of both oxygen and hydrogen.—*Zeit. fuer Elektrochemie,* Jan. 31.

Electrolytic Dissociation of Solutions.—ARRHENIUS.—The first part of a general historic review of the development of the electrolytic dissociation theory.—*L'Ind. Elec. Chim.,* Nov.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Wehnelt Interrupter.—MIZUNO.—An illustrated account of some experiments concerning the function of self-induction in the Wehnelt interrupter. In the conclusion, he gives the following interesting comparison of an induction-coil and a Wehnelt interrupter: "In an induction coil the suppression of sparks due to the extra current is indispensable, so that a capacity of a certain requisite value must be inserted across the interrupter. The deficiency of capacity diminishes the oscillations in the primary circuit in consequence of the spark due to the extra current and therefore the latter spark must be avoided as much as possible. On the other hand, in Wehnelt's interrupter the spark due to the extra current is necessary in order to keep up its action. Without such spark the vapor at the active electrode cannot be got rid of, and consequently sufficient current cannot be established anew. The actions of capacity and self-induction are thus directly opposite to each other in the two cases."—*Phil. Mag.,* Feb.

Obtaining Alternating Currents and Voltages in the Same Phase for Fictitious Loads.—DUDDELL.—A communication, referring to the methods of Campbell of using a transformer to obtain a fictitious alternating non-induction load for tests; also for use in a method for the measurement of power in an alternating-current circuit. (Digest, Dec. 16, 23.) In both cases it is assumed that the waves of p. d. between the terminals of the primary and of the secondary are practically similar curves and in phase. Duddell shows that the existing phase difference introduces negligible errors in the first case, but might cause considerable errors in the second case when the power factor of the circuit to which the supply of power is being measured is low. He also makes some critical remarks regarding Campbell's "Phase-turning device."—Lond. *Elec.,* Feb. 8.

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Magnetic Tests of Iron.—KAMPS.—An article in which he gives formulas and describes a method for determining the error in magnetic measurements, due to the film on the surface of iron sheets, which chemically consists of a mixture of ferric oxide and ferrous oxide.—*Elek. Zeit.,* Jan. 24.

Instruments for Cable Tests.—EDELMANN.—An illustrated description of portable sets of apparatus for use in cable tests.—*Elek. Zeit.* Jan. 24.

TELEGRAPHY, TELEPHONY AND SIGNALS.

A Tuning System for Wireless Telegraphy.—BULL.—An illustrated description of a system, in which the signals are conveyed from the transmitters to their corresponding receivers exclusively by the aid of series of impulses, each series consisting of a certain number of short-wave impulses following each other at predetermined intervals of time. By a suitable choice of these intervals, the impulses can be arranged in various series of different form. Now it is possible to tune each transmitting and receiving pair for its own special series in such a way that the transmitter only dispatches the series of this special form and the corresponding receiver only responds to a series of the same form. In the transmitter, a paper tape passes first a perforating device; a number of contact brushes are arranged adjustable for various distances apart, and they press lightly against the tape. When a brush passes a hole in the tape, contact is made. By various adjustment of the brushes the form of the series can be altered. In the receiver the same number of brushes as in the transmitter are used. The various series are formed in such a way that the time intervals between any two impulses in them are all different. The system is said to be especially suitable for the type-printing apparatus of Hughes.—Lond. *Elec.,* Feb. 8.

Wireless Telegraphy.—BLOCHMANN.—An illustrated paper read last June before the Union of German Elec. Eng. He considers the medium between the transmitting and receiving station, and develops the idea that in wireless telegraphy there are no Hertzian waves propagated, but the action is based upon disturbances of the equilibrium of the electrostatic equi-potential surfaces which surround the earth. The action in wireless telegraphy is a disturbance of the normal conditions of atmospheric electricity and may be compared with water waves. From this he concludes that it is impossible in principle to make any arrangement of the transmitting and receiving apparatus, as used at present, in such a way that the disturbances generated by a transmitting station are directed so that they reach only one certain receiving station and no other in the neighborhood. —*Elek. Zeit.,* Jan. 24.

Submarine Telegraph Cables.—CASEVITZ.—A paper giving a large amount of statistical information on submarine telegraph cables, especially those laid by France. From 1889 to 1900 the length due to France has increased 125 per cent, against an increase of only 19 per cent for England; but the English total length at the present time is more than six times the French, while to England in addition are due both the laying and the maintenance of all the cables for the United States, amounting to more than one-fifth of the total length belonging to England. There are 41 cable ships now in use throughout the world. Some information is also given regarding new French cable schemes and some suggestions are made.—*Mem. de la Soc. des Ing. Civ. de France,* 1900, p. 365; abstracted in *Brit. Inst. Civ. Eng. Abstracts,* v. 143, pt. 1.

Insulated Telephone Wires.—HACKETHAL.—A communication referring to his system of using insulated wires for telephone lines. He replies to the criticism which has been raised that this system would increase the capacity of the line and thus be harmful in long distance telephony. He denies this, and gives the results of tests made by Heim on two lines, each of 2½ miles length, one of bare wire, and the other insulated by his system. The result was that the capacity of both lines is nearly equal.—*Elek. Zeit.,* Jan. 24.

REFERENCES.

Rowland Telegraph.—ROBICHON.—An illustrated description of the system of multiplex telegraphy invented by Prof. Rowland and shown at the Paris Exposition, as noticed before in the Digest.—*Jour. Teleg.*, Jan. 15.

Grand Rapids.—An article on the co-operation telephone system at Grand Rapids, Wis., where 300 instruments are now in use.—*Eng. News*, Feb. 14.

Norway.—An illustrated article giving "A few notes on the construction of telephone lines in Norway," especially on the appearance of the poles, etc.—Lond. *Elec. Rev.*, Feb. 8.

Statistics.—A statistical review on telegraphy in Europe in 1900; also the conclusion of an article on telegraphy and telephony in France; also a continuation of the article on telegraphy and telephony in British India in 1898, 1899.—*Jour. Teleg.*, Jan. 25.

MISCELLANEOUS.

Paris Exposition.—REYVAL.—A well illustrated description of a 750-kilovolt-ampere Boucherot compound alternator, exhibited by Breguet, which has already been described in the Digest.—*L'Eclairage Elec.*, Jan. 26. Illustrated description of a 350-kw single-phase alternator, the voltage being 2000, the frequency 42.5, the number of poles 36, the speed 142 r. p. m.; also a 460-kilovolt-ampere, two-phase alternator of a Geneva company, the voltage being 5000, the frequency 46.66, the number of poles 16, the speed 350 r. p. m.; also an automatic regulator for installations of the Thury system.—*L'Eclairage Elec.*, Feb. 2.

LAVEZZARI.—A description of self-acting electrical signals, used on the electrical railway at the Paris Exposition.—*Mem. de la Soc. des Ing. Civ. de France*, 1900, p. 436; abstracted in *Brit. Inst. Civ. Eng. Abstracts*, v. 143, pt. 1.

SANDER.—An illustrated article in which he makes some general remarks on large alternators exhibited at the Paris Exposition.—*Zeit. f. Elek.*, Feb. 3.

DE MORSIER.—An illustrated description of the small motors exhibited by Lecoq & Co.; they are built for them 1/20 to 4 hp.—*Rev. de l'Elec.*, Jan. 31.

HAUSEGGER.—The first parts of a long and well illustrated description of the exhibits of Ganz & Co.—*Zeit. f. Elek.*, Jan. 20, 27, Feb. 3.

New Book.

LEÇONS D'ELECTROTECHNIQUE GÉNÉRALE. Professées A L'Ecole Superieure D'Electricité, par P. Janet. Paris: Gauthier-Villars. 614 pages, 307 illustrations. Price, 20 francs.

This volume is a remarkably useful addition to the literature of electrotechnics. It fills a real gap in the treatment of the subject, discussing, as it does, the practical topics of applied electricity in the clear-cut academic fashion in which our Gallic friends excel. Most books, perhaps all, in our own tongue belong either to the so-called practical type, surcharged with details of machines which will adorn the scrap heap in four or five years, or to the class stigmatized as theoretical, which runs to elaborate mathematical proofs of theories which nobody disputes or puts to any useful purpose.

Books which take up and discuss simply and clearly the theoretical basis of the practice of designer and engineer are rare, and M. Janet is to be congratulated on having produced one of the best of this class. One feature is to be especially commended—the addition to each chapter of a brief bibliography of the subject-matter as found in the chief French electrical journals of the last decade, which is most convenient for the student who desires to go carefully into any particular topic.

Another admirable innovation is a long and very interesting chapter on the materials of electro-technics, a topic too often treated in a desultory and careless manner.

The larger half of the volume is taken up with alternating currents and their applications, discussed on the whole in a very clear and satisfactory way, and brought thoroughly up to date. In the chapter on asynchronous motors the author is perhaps rather less satisfactory than elsewhere, holding too closely to the ordinary mathematics of the rotary field, and thereby missing the more finished and really simpler treatment introduced by Steinmetz and the German writers on the subject. But this is a small flaw in a book in other respects remarkably up-to-date and satisfactory.

British Transformer Practice.

IT is perhaps in Great Britain, more than in any other country, that the single-phase alternating current system of electric lighting continues to be most generally favored, and consequently British manufacturers may be expected to give to other countries some of their experiences in this direction.

It cannot be doubted that their labors meet with very much criticism, but at the same time, on comparison with the work of other countries, there is a great deal in their designs which will prove beneficial to the electrical world in general. The particular conditions with which they have had to deal, and the difficulties they have had to overcome, have given them unique opportunities to indicate the lines on which future practice should run.

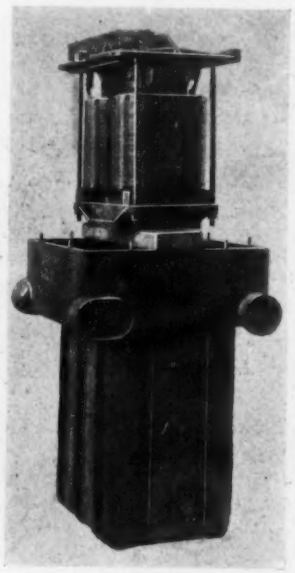


FIG. 1.—TRANSFORMER AND TANK.

In the early days of electric lighting the single-phase system was well received on account of its extreme simplicity of working, compared to the direct current method, and at the outset made such headway that in spite of all opinions to the contrary in Great Britain it still stands unrivaled as the ideal system of supply. The existence of an opponent in the shape of direct current, however, has only acted as a stimulant to manufacturers of single-phase apparatus, who, with the examples of failures before them, have done all in their power to improve the particular attributes of the system they advocated. A glance at some of the large single-phase stations recently erected in England, at the vast number of extensions carried out to some of the older plants, will serve to show that the labors of constructors have not been in vain, and that single-phase apparatus has been vastly improved since its first beginning. Probably the greatest change of all can be said to have taken place in the design of the transformer. This heretofore abused adjunct of single-phase working has passed from the sphere of "burn outs" and "short circuits" to that of reliability and efficiency; and whereas it was an expensive item of the

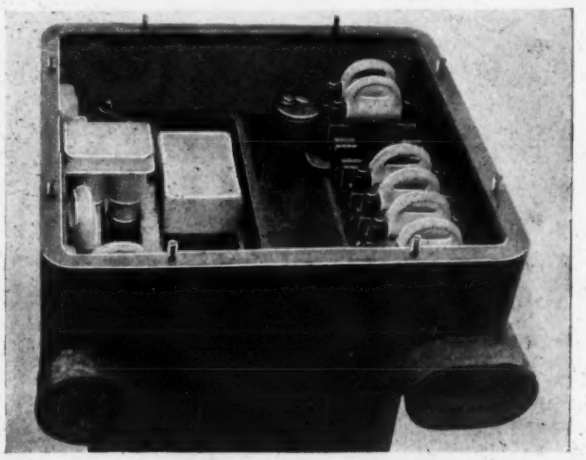


FIG. 2.—TRANSFORMER CONTACTS.

supply to buy and maintain, it can now be procured at low cost while its up-keep is a negligible quantity.

The general practice of placing all cables beneath the street (as enforced by Board of Trade regulations) has had considerable influence on the design of transformers—so much so, indeed, that attempts have been made, and with considerable success, to confine all transformer operations to the roadways in which the feeders are laid.

The work of Messrs. S. Z. de Ferranti, Ltd., Hollinwood, in this direction is worthy of notice, insomuch as they are the pioneers of single-phase working in England, and have done much to place the transformer on a more efficient basis. In fact, it is chiefly due to their

efforts that single-phase systems generally have been able to maintain their own against strong opposition.

As to street transformers, a glance at some of Messrs. de Ferranti's designs for this purpose will serve to illustrate the manner in which they have dealt with the subject. It must be remarked here that the principle adhered to is the arrangement of the transformers in such a manner that expensive buildings and excavations are unnecessary, while the safety from contact with high pressure terminals is well assured. These desirable features are obtained by designing the apparatus in the following manner:

FIG. 3.—STATION TRANSFORMER.

A cast-iron tank, made in one size only, *i. e.*, to receive transformers up to 50 kilowatts, is sunk under the level of the pavement. This tank is provided on the one side with contacts and terminals for the high-pressure cables which enter from either end, and on the side are fixed the fittings for the low-pressure cables. Both primary and secondary mains enter the tank through water-tight glands, which reduce the possibilities of the entry of moisture to a minimum. Two glands are provided for the high pressure and four for the low-pressure feeders, the contacts of the former being so arranged that by the insertion of plugs the main will not be interrupted when the transformer is removed. The terminals above mentioned are fixed to the side of the tank, therefore permanently attached to it when sunk in the ground.

The transformer, which has a U-shaped core, is clamped between two plates, the upper of which carries the high and low pressure contacts arranged to come in line with the contacts of a similar nature fitted to the tank. This arrangement permits the removal of the transformer from the tank without interruption to the supply.

In Fig. 1 the transformer and tank can be seen, the former being ready for lowering into its place, while in Fig. 2 the general appearance of the transformer and contacts will be evident. On the right are the plug fuses connecting the low-pressure cables to the secondary winding, together with a Cardew earthing device to protect the same winding in the event of connection with the primary.

On the left will be seen the high-tension oil-break fuse placed on the inner conductor of the cable, and the outer connection of the transformer being made by means of a solid plug, while similar plugs are provided to maintain the continuity of the primary main when removing the transformer. In the left centre of the tank will be seen a porcelain tray which contains chloride of calcium for the absorption of all moisture which may condense inside the tank. Reference to the diagram shown by Fig. 6 will make the connections of both high and low tension cables quite clear. It must be noted that concentric mains are provided for. In this illustration *P* are low-tension plug fuses; P^1, high-tension fuses; *F*, high-tension oil-break fuses; *C*, Cardew earthing device; *PW*, primary windings; *SW*, secondary winding. From the above it will be seen that the de Ferranti street converter meets almost all the requirements of the case. Transformers varying in size from 5 to 50 kilowatts can be placed in the one tank, which, when once buried in the ground, need not be disturbed. The transformers can be handled with safety while the supply is being maintained, and no interruption need take place should it be necessary to remove a transformer at any time. That the high-pressure contacts are well guarded will be seen from Fig. 5, in which *A* is the high-tension oil-break switch; *B* the high-tension inner plugs; *C*, porcelain ferrules covering the high-tension inner terminals; *D*, high-tension inner terminals; *E*, high-tension insulator case.

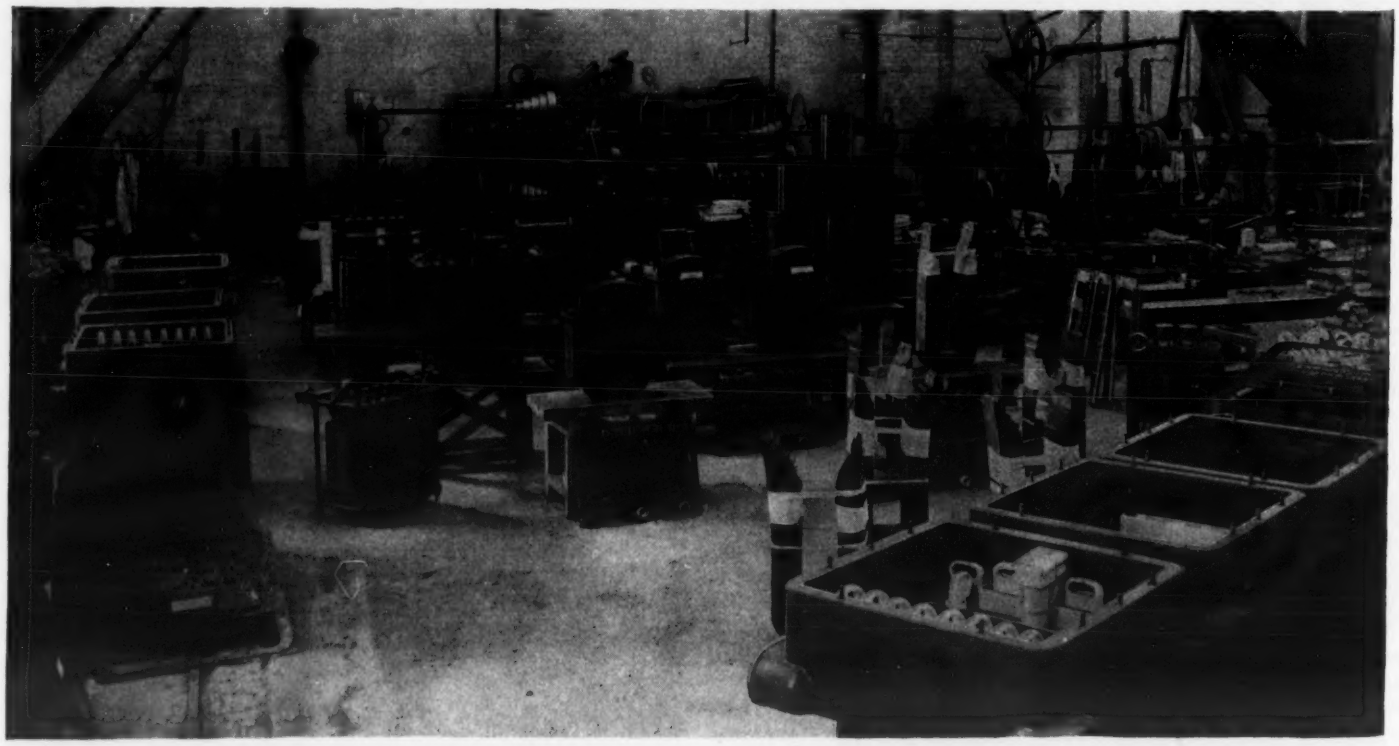


FIG. 4.—DE FERRANTI TRANSFORMER DEPARTMENT.

When it is considered that so many lives have been lost on transformers which have been insufficiently guarded, the advantages which proper protection affords will become evident. The manufactures of Messrs. de Ferranti in the direction of transformers are, however, not confined to street transformers.

Without alteration to the cores or windings, their transformers can be adapted for central station use by being placed in a special cover. The contacts with this type are arranged in wells at each side of the base, where all terminals are carefully protected and each cable sealed.

Another adaptation is found in the type suitable for sub-station use, the transformer in this case being lowered into a cast-iron tank placed on the floor of the sub-station. The cables enter at the upper part of the tank and are connected to suitable contacts inside the

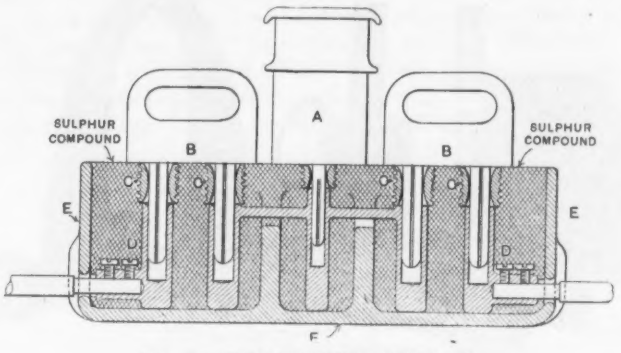


FIG. 5.—HIGH-PRESSURE CONTACTS.

case, the high-pressure terminals being carefully guarded, as before. An exterior view of this arrangement is given in the photographic reproductions which make up Fig. 3.

From the foregoing it should be evident that the transformer designs of Messrs. de Ferranti are well suited to almost every requirement, the standardizing of the converter proper making it possible to meet special circumstances which necessitate departure from standard types. It is needless to remark that the best material is used in the construction of these transformers, no pains being spared to render them thoroughly efficient, while the price is also kept down. With manufactures of this description it is very difficult to strike the middle course between cheapness and good material, combined with efficiency and reliability, but it can be said that Messrs. de Ferranti have been successful in their efforts, and can produce apparatus which is second to none on the market. Such a circumstance is but the outcome of their lengthy experience in the construction of this class of appliance for the equipment of alternating current stations, and they can be said to have maintained in every way the lead which

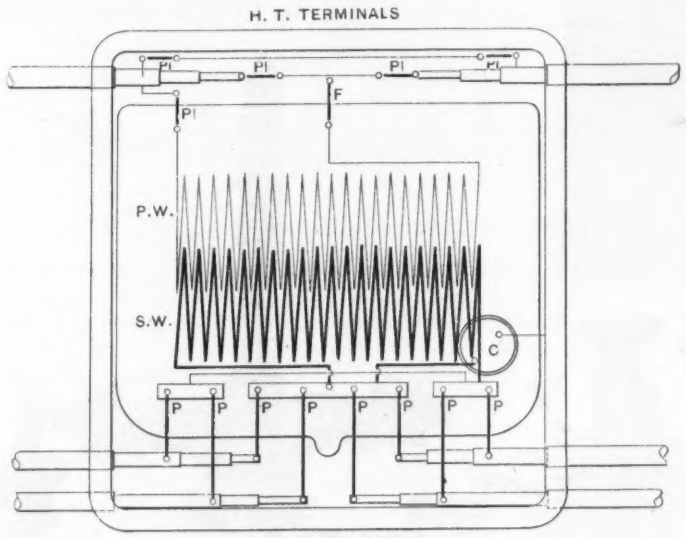


FIG. 6.—DIAGRAM OF TRANSFORMER.

they established as the pioneers of single-phase systems, by the all-round excellence of their manufactures.

Some idea of the extent of the work now being done by Messrs. de Ferranti, Limited, in the manufacture of transformers, can be gathered from Fig. 4, which illustrates a portion of the winding shop, and it will be seen from the number of street tanks dotted about that their efforts in this particular are widely appreciated.

Sectional Third Rail System on the Baltimore Belt Line.

IN August, 1895, the Baltimore & Ohio Railroad Company put in service a system whereby all trains on the section known as the Belt Line were hauled electrically. This section comprises a tunnel going directly under the heart of Baltimore, and a curve and grade which the steam locomotives found very difficult to traverse. In addition to this, the puffing of the locomotives in the tunnel under the severe load imposed by heavy grade caused the atmosphere inside the tunnel to become practically unbearable, a disadvantage which electricity has eliminated. The method of conveying current to electric locomotives was a serious and costly undertaking, and after much study a system of overhead conductors was decided upon. This system was exhaustively described by the technical press at the time of its installation, and it is sufficient to say here that it was very expensive, costing in the neighborhood of $400,000 for the three odd miles of equipment; and while it served its purpose with a moderate degree of satisfaction, the depreciation and cost of maintenance was so heavy that the Baltimore & Ohio Railroad Company has made a change to an improved third-rail system.

The installation of the simple third rail was a matter not to be thought of, for in front of the Camden and Mt. Royal stations the

FIG. I.—MT. ROYAL STATION.

live conductor would be in so exposed a position that it would constitute a serious source of danger to passengers. In many portions of the Camden yard similar objections obtained, since trackmen walking back and forth might suffer severe injury. The escape from this difficulty was plainly to sectionalize the third-rail in the places where it was desired to secure safety, and to control each section by an automatic switch.

The selection of this switch was by no means an easy matter. There was at that time nothing on the market to handle currents of 1000 amperes at 650 volts, and the problem was presented for solution to various companies exploiting sectional-conductor systems. The Murphy Safety Third-Rail Electric Company submitted drawings which met the approval of the Baltimore & Ohio engineers, and switches were made in accordance therewith and duly installed. The system is just now going into service, and the preliminary tests made upon the same have demonstrated that it will operate to the entire satisfaction of those concerned. Among the most important of these was the hauling of 22 steel freight cars loaded with coal through the tunnel and around the curve at the top of the hill, which was done with the greatest of ease. All trials have been successful and have proven the efficacy of the system, which possesses features of considerable interest.

There are at present installed at Baltimore 22 switches controlling a corresponding number of third-rail sections. Eleven of these are in the Camden yard, and protect the entire yard from the power house to the tunnel. Through the tunnel the live rail is used, and the sectional system begins again within the tunnel about 200 ft. from the Mt. Royal portal and continues past the Mt. Royal station to what is known as the twin tunnel some 2000 ft. beyond. At Hunt-

ington Avenue a grade crossing is protected by still another section. The switches are operating so satisfactorily that negotiations are now being made to cut up the rest of the live third rail and equip the same with switches.

The most important detail of a sectional third-rail system is the switch which automatically makes the rail alive while the car is passing and immediately cuts it out of circuit as soon as the collecting shoe leaves the section. This has, in fact, long proved the stumbling block in the practical operation of systems of this kind, and until now has been the chief obstacle to their introduction. The large currents for which they must be built and yet the positiveness with which they must remain closed when but a small fraction of the maximum current is being used, necessitate a combination of strength and delicacy which has for years baffled inventors and prevented the successful solution of the problem.

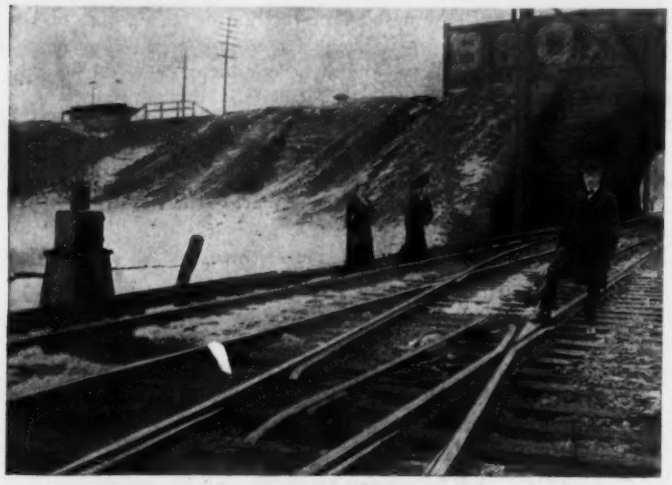


FIG. 2.—HUNTINGTON AVENUE CROSSING.

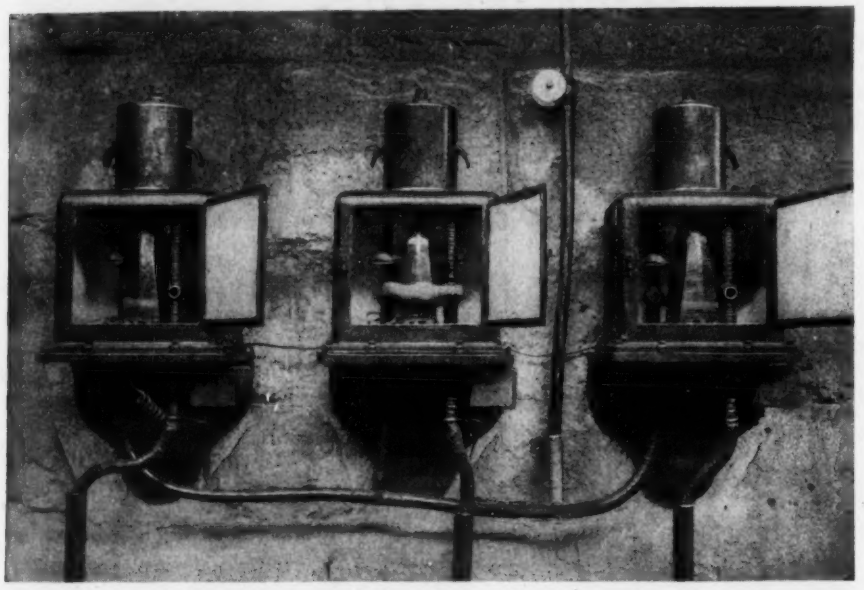


FIG. 3.—GROUP OF SWITCHES.

The illustrations of the switch used in Baltimore which are presented herewith give an excellent idea of its appearance, but a few words of explanation will be required to show how the various difficulties in its construction have been overcome. From the base to the top of the cast-iron case the apparatus is about 2½ ft. high. The weight is about 500 lbs. and to facilitate its transportation and the placing of it in position the switch is provided with a heavy lug on each side, as shown in the engravings. Access to the interior is provided by means of a large opening in the front, which is closed by a solid cast-iron door. This door can be securely fastened to prevent malicious tampering with the working parts, and when closed it makes a weather-proof seal to the interior. As the case is made of a single casting with no openings except the doorway and the holes in the bottom for leading in the electrical conductors the switch can be placed in the severest climate without fear of the elements preventing its satisfactory operation.

The principles upon which the system works are as follows: The locomotive contains an air-storage tank connected to an air engine and dynamo. One terminal of this dynamo is connected to the truck and the other to the collecting shoe so that when the locomotive reaches a dead section current tends to flow from the third rail to ground. In the normal (open) position of the switch a shunt coil of fine wire is connected to the third rail by means of the main feeder connections, the other end of the coil being grounded. The current from the dynamo on the locomotive, therefore, as soon as the shoe touches the section or the motorman turns on his controller energizes this shunt coil. Within the coil is a large iron plunger from the lower end of which branch out arms supporting the main switch jaws, and surrounding it is a massive copper series coil made of a single casting which is in the main circuit. The magnetic pull of the shunt coil lifts the plunger and throws the switch jaws together, thus connecting the feeder with the section of rail controlled by the switch. The locomotive now receives current from the feeder, which current, flowing around the series coil, holds up the plunger and keeps the switch closed. As soon, however, as the collecting shoe has passed from that section the current ceases and the plunger dropping from its own weight the circuit between the feeder and rail is again opened. The shunt circuit passes through carbon contacts at the base of the plunger, the plunger itself forming part of the

FIG. 4.—HEAVY PARTS OF SWITCH.

FIG. 5.—PLUNGER AND SWITCH DETAILS.

circuit. When it is lifted by the shunt coil, therefore, the shunt circuit is broken at the contact points and the plunger held up by the action of the series coil alone. As small a current as 23 amperes is sufficient to maintain the switch closed. Should no current be taken from the third rail after the shunt coil has raised the plunger the latter will drop back to its normal position, again closing the shunt circuit and again being lifted, continuing to oscillate thus up and down until the shoe leaves the rail or current is taken from it of sufficient strength to energize the series coil.

The locomotive is provided with two collecting shoes placed about 28 ft. apart and electrically connected. When the forward shoe reaches the dead section in front of the train current immediately flows from the rear shoe, which is on a live section, to the dead section and operates the switch in the same manner as did the auxiliary dynamo current described above. On the other hand, when the rear shoe leaves a section the forward shoe is taking current from its rail so that the current is not interrupted as the rear shoe slides over the insulation between the sections. As soon, however, as it has left a section that section ceases to supply current, the series coil of the switch controlling it is no longer energized, the plunger falls and

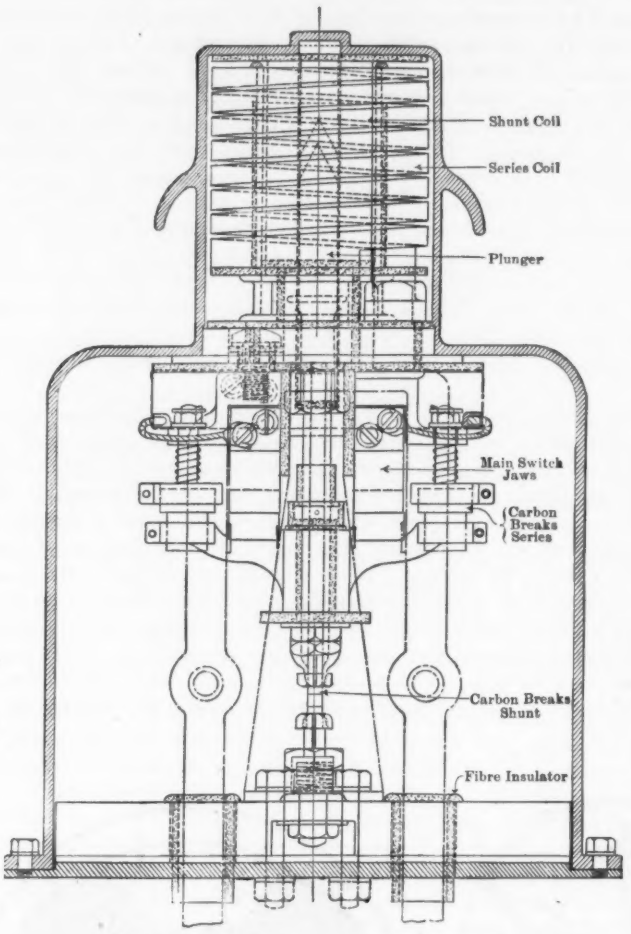


FIG. 6.—CROSS SECTIONAL VIEW OF SWITCH

the section becomes dead. Before the main jaws can open there will be practically no current on the switch, and, therefore, no arcing; but large carbon breaks are provided which remove all possibility of injuring the jaws and interfering with the smooth action of the device in continuous service.

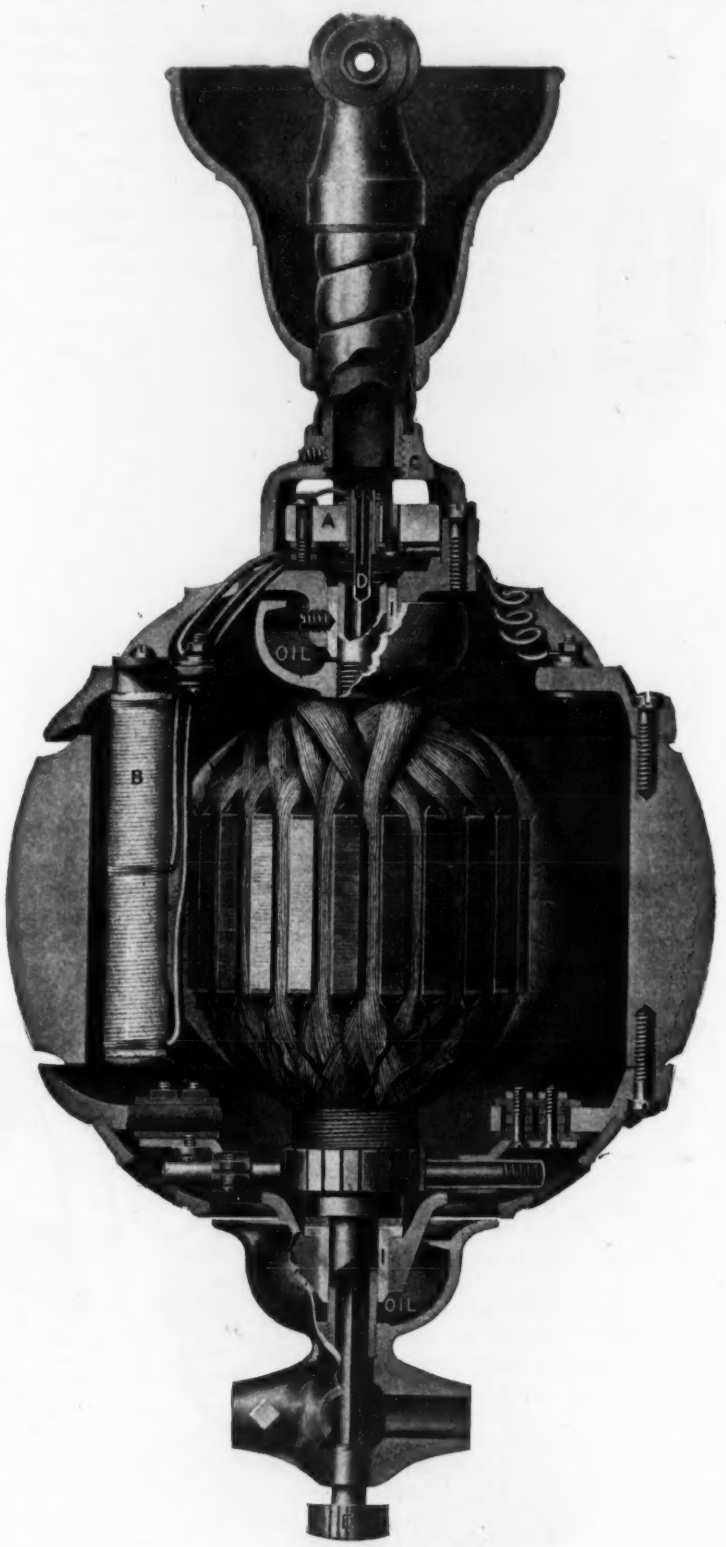
While the locomotive is receiving current from the third rail the dynamo on the engine runs as a motor storing air in the receivers and holding it in readiness for the next stop. Specially designed pneumatic valves are arranged so as always to provide a supply of air so that a locomotive is always ready to pick up the plunger in the switch and connect this third rail with the feeder.

The Pennsylvania's New Power Plant.

The plans for the new electric light plant and power house which the Pennsylvania Railroad Company is erecting in connection with a new depot at Pittsburg have been turned over to the contractors. The building for the plant will be 312 by 47.1. The material will be stone and terra cotta. The smoke stack will be 253 ft. high. There will be Babcock & Wilcox boilers of 2500-hp capacity, with Roney stokers and Hunt conveyors for the handling and consumption of fuel. In the engine room there will be four marine-type Westinghouse engines direct-connected to the same number of Westinghouse alternating-current dynamos of 350 kw. There will also be one steam-driven and one motor-driven exciter.

"Standard" Ceiling Fan.

The accompanying illustration shows the construction of the 1901 model direct-current "Standard" ceiling fan manufactured by the Robbins & Myers Company, Springfield, Ohio. The bearings are



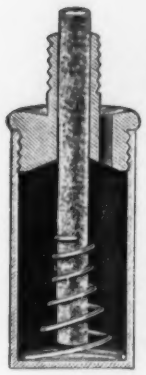
CROSS SECTION OF CEILING FAN.

supported by and centered in end plates which, together with the yoke ring, form a spherical case which encloses the armature and field. The company has adopted a new system of fitting these plates which, it claims, secures absolute alignment of bearings with-

out resorting to swivel sleeves. This improvement, it states, increases rigidity of construction and eliminates noise.

The illustration shows the disposition of the regulating resistance and porcelain switch. These parts are connected up independently, and may be placed in position or removed without disturbing any of the mechanism of the fan, as there are no wires leading through the shaft as in previous models. The oiling system is also shown in the illustration. The company makes a line of desk and bracket fans besides the ceiling fan above described.

Improved Oil Cup.



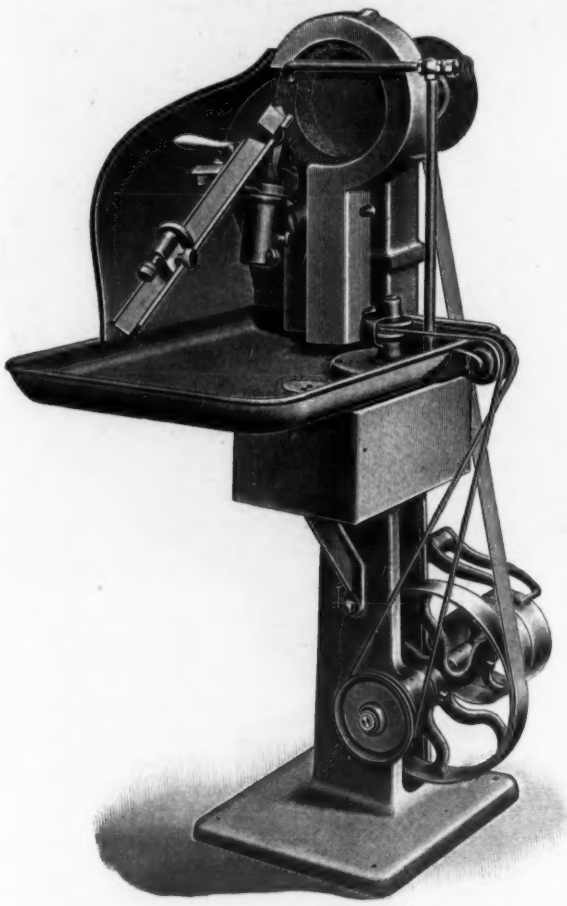
5-H OIL CUP.

The oil cup illustrated herewith is used on fan motors, motors and other high-speed machines, when it is desired to feed the oil steadily to the lower side of the shaft only when it is in motion. When the shaft is not running the cup will not feed any oil. The wick is made of hard felt and the cone-shaped spring to which it is attached keeps it upright. The flow of oil is regulated by the pressure of the wick against the shaft, an increase of pressure increasing the flow. The wicks are furnished in lengths required to obtain the proper pressure. As an example, by having a pressure of 4 ozs. the flow of oil will be so regulated that a 5-H cup once filled will lubricate a ⅛-hp motor 50 to 60 days. The cup holds 50 drops and the bearing uses at the rate of 1 drop per day of 10 hours. The device is manufactured by the Bowen Manufacturing Company, of Auburn, N. Y., which also manufactures felt washers, wicks, strips and special shaped pieces of felt of any kind or size.

The "New American" Wet Grinder.

This new wet grinder has for its foundation the regular style of drill grinder described and illustrated in our issue of Jan. 26. The emery wheel is protected with ample water guards to prevent the water from being thrown over the floor and the operator as well. The water is delivered to the wheel just above where the work is being done, and in this way the full benefit of the water supply is obtained. A large water pan is provided from which the water drains into a reservoir with two compartments, one for a settling chamber and the other containing clear water in which the centrifugal pump, which furnishes the water supply, is submerged. This centrifugal pump is mounted on a vertical axis, which is claimed to be an advantageous arrangement. It is driven by a round belt coming up in the rear of the machine from a pulley on the countershaft over idler pulleys to the vertical shaft of the pump. The supply of water may be regulated by the valve shown in the angle of the pipe and may be shut off entirely when it is desired to use the wheel dry.

This wet grinder, which is manufactured by L. S. Heald & Son, Barre, Mass., is a satisfactory machine where the majority of the drills are of large sizes. There is less danger of drawing the temper when the wheel is provided with abundant supply of water.

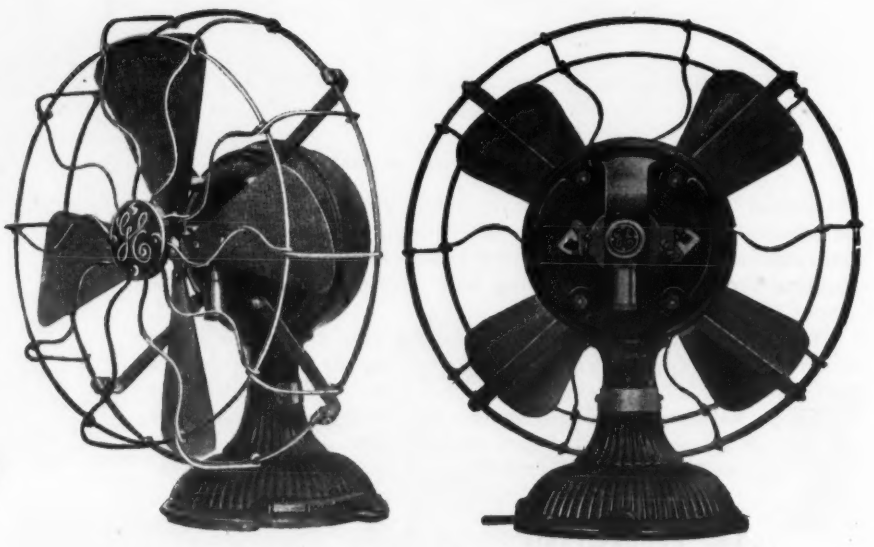


WET GRINDER.

General Electric Fan Motors.

For the season of 1901 the General Electric Company is offering a complete line of fan motors for both alternating and direct-current circuits. The alternating-current motors have no moving contacts. The cast-iron frame surrounds the armature of laminated soft iron with bare copper conductors—the field coils being mounted on a laminated iron frame. The regulating device includes a three-point switch which is placed in the back of the desk motors and in the base of the wall and bracket motors, and operated by a projecting key, so that no additional switch is required. These motors will run at two different speeds. They are furnished for circuits of 60, 125 or 133 to 140 cycles and 52, 100 to 108 and 108 to 115 volts. They can be supplied for 220 volts. The motors are finished in standard black enamel with four-blade polished brass fans and polished brass guard and trimmings. They are furnished in three sizes, with 12, 14 and 16-in. fans.

The direct-current fan motors are made with elliptical bodies, and are dust-proof with a removable shield over the commutator end, which permits access to the brushes and brush holders for examination and cleaning. The brush holders have been designed so as to insure a uniform pressure of the rectangular brushes against the commutator and to prevent them from turning and presenting a sharp edge to its surface. These motors are provided with a four-point regulating switch placed in the base of the motor, which allows three different speeds. The bearings are lubricated by oil fed by a wick pressed against the shaft by a light spring. The direct-current motors are furnished with 12 and 16-in. fans. The desk motors are furnished with solid frames, with swivel frames or with swivel and trunnion frames. Wall bracket motors are furnished with swivel and trunnion frames.



FIGS. 1 AND 2.—FAN MOTORS FOR 1901.

The company also manufactures a special wall bracket motor of attractive design for both direct and alternating-current circuits.

This is furnished with either black japan iron suspension frame or where more elaborate finish is desired, with brass arm and trimmings. As a convenience for persons desiring to use one wall motor in several different rooms, the company supplies separate wall brackets on which the motors of a certain size and capacity are interchangeable.

The ceiling fans furnished by the General Electric Company are for use on direct-current circuits and furnished with either two, four or six blades, either slow or high speed.

Telephone Wood Work.

The Gilliland Electric Company, Adrian, Mich., has resumed on a large scale the manufacture of telephone and electrical specialties. The Gilliland Company, which was organized in 1887, for many years manufactured the pins and brackets for some of the largest telephone and telegraph companies in the United States. Mr. James F. Gilliland, the manager of the company, is one of the best-known telephone men in the business. He comes of a family of well-known telephone men, and himself has invented and patented large numbers of electrical and telephone dvices. The Gilliland Company has installed complete wood and metal working machinery for making all forms of cabinet work, pins and brackets, and is also equipped to manufacture many specialties which ordinary manufacturers could not handle. The plant of the Gilliland Company is stated to have a capacity to employ 1000 men.

Universal Motors for Factories.

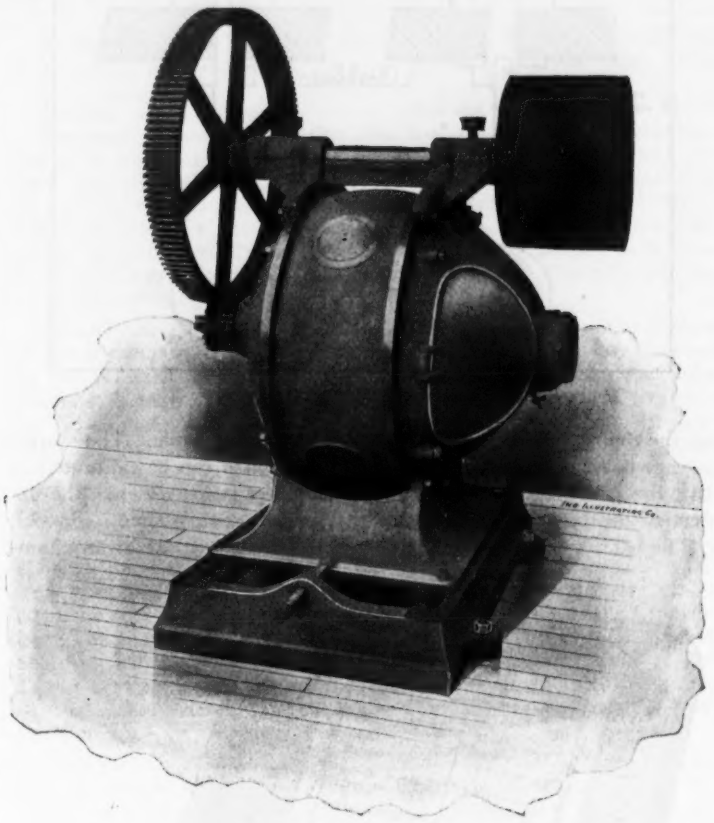
The Jenney Electric Manufacturing Company was a pioneer in the construction of direct-current motors for power purposes, and has maintained a reputation for the excellency of its product. A careful study of the conditions existing in manufacturing establishments and long experience resulted in the design of the "Universal" type of motor. The success of this form of motor was so immediate that a full line of machines from 1-3 to 75 hp has been placed on the market. The motors can be direct connected, geared or belted to any machine, and the designs contemplate such a full variety of speeds. Each size is wound for three standard voltages, 125, 250 and 500, and three standard speeds, slow, intermediate and moderate. To fulfil requirements of very slow speed, a reducing gear is attached to the motor frame, diminishing the speed to approximately one-fifth.

The arrangement of the base and back gear is such that the motor can be placed on the floor, wall, ceiling, or upon a support on the machine driven. When the motors are exposed to dust, moisture or flying particles they should be entirely encased. Access to the commutator and brushes is obtained through hinged doors, with dust-proof lining which enables the motors to be used in mills, mines and factories where there are explosive vapors or excessive moisture. Only the best materials and workmanship are employed, and the works in Indianapolis are equipped with every facility for manufacturing these machines in quantity.

The new and extensive works of the United States Playing Card Company at Cincinnati have electrical equipment throughout. After careful investigation and exhaustive tests, an order for over 150 motors was placed with the Jenney Electric Manufacturing Company. Among this number 40 1-3-hp slow-speed were directed connected to punch presses, and 4 2¾-hp compound-wound motors, with ventilated heads to prevent flying particles from getting into the armature and commutator, drive Cottrell printing presses. The other motors are direct connected, geared and belted or connected through reducing gear and attached in nearly every different manner to machines requiring every kind of duty.

Another extensive plant recently equipped is that of J. P. Mathieu & Co., of Philadelphia, one of the largest tanners of fine hides in the country. The Jenney Company has supplied and has an order for three 225-kw, 250-volt, 3-bearing generators for power purposes and one 100-kw, 115-volt lighting dynamo. In service these machines have carried overloads of between 50 and 60 per cent for five hours continuously without serious heating or sparking. The machinery is operated by 24 motors ranging from 5 to 60 hp. Most of these motors are running where the atmosphere is surcharged with moisture, so that it was necessary to make them practically water proof. This was accomplished by a solid back head and hinged doors on the front head.

During the past six months the Marsden Company, of Philadelphia, has equipped three plants, at Linden, Ind.; Peoria, Ill., and West Point, Va., for the manufacture of cellulose. Each plant requires one 125-kw, 230-volt direct-connected generator, and 75 and 50-hp motors. As cellulose under certain conditions is one of the most powerful explosives, it is essential that the motors be entirely dust-proof. The Jenney machines have successfully performed the unusual service here required. It has been very gratifying to the company to have additional or duplicate orders follow the first installations in large plants in nearly every instance. This is the most convincing testimony of the excellent service rendered by the Jenney motors under all conditions.



UNIVERSAL MOTOR.

Portable Testing Set.

Messrs. Queen & Co., of Philadelphia, Pa., have made some recent improvements in their Acme portable testing set, by which the range and accuracy of measurements are greatly increased, and at the same time the mechanical construction has been improved. An important change has been made in the construction of the metal blocks of the Wheatstone bridge and rheostat. Usually the block is merely held to the rubber plate by the threaded end of a small rod screwed into the block. A disadvantage of this method is the small area of contact between the block and rod, and in time the threads are liable to become oxidized and a poor contact ensue. In the new construction, however, these objectionable features are obviated by using part of the block itself to extend through the rubber plate and take the check nut below. A small rod, to which the end of the wire comprising the resistance coil is soldered is also soldered into the bottom of the brass block. There is therefore a complete soldered circuit from the plug contact through one block and rod with its resistance coil, back through the end rod and block and suceeding plug contact. It is only necessary to keep the plug contact clean and bright to be positive that there will be no change of resistance in the interior of the set. Furthermore, the bottom of the metal block is provided with a knurled surface, as shown at *K*, so that the little corrugations will be tightly forced down into the rubber plate, securely fastening it and preventing the block from turning when the plug is inserted. The ordinary construction has a smooth lower surface and slipping is liable to occur.

The galvanometer is of the D'Arsonval type, which is uninfluenced by external mechanical or magnetic disturbances. The coil is long and light, and swings in an intense magnetic field, so that the sensibility is high. The system is so well balanced that the set can be used in any position, and, it is stated, will give as accurate indications

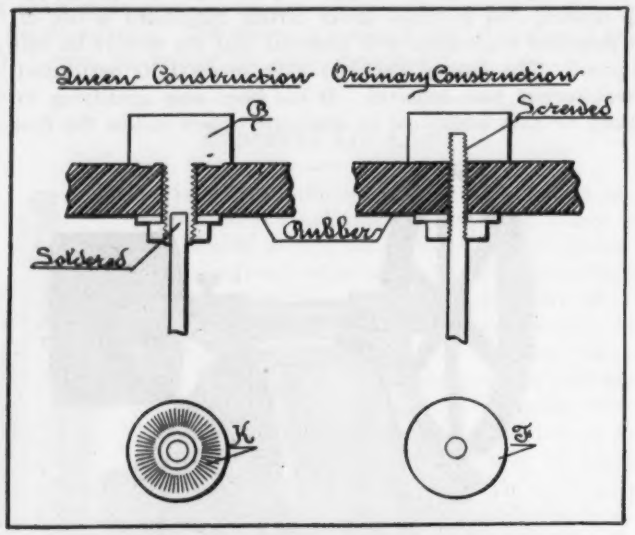


FIG. 1.—IMPROVED METAL BLOCKS.

on the top of a telephone pole as on a laboratory table. The system is very deadbeat, and has a uniform scale which can be calibrated so that the instrument can be used in insulation measurements, the deflection on the scale representing the insulation resistance.

The battery consists of four special dry cells, any one or any number of which can be used as desired. They have a large current capacity and a high e. m. f., and are found to give much better results than the old silver chloride type which heretofore have been universally used.

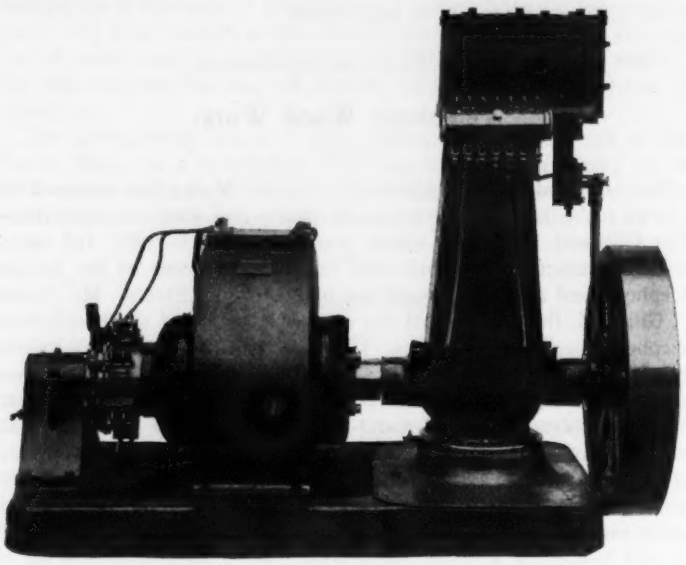
FIG. 2.—PORTABLE TESTING SETS.

The set is enclosed in a substantial and well finished oak case.

A Compact Electric Generating Outfit.

In designing the outfit illustrated herewith the builders, Engberg's Electrical & Mechanical Works, St. Joseph, Mich., have aimed to produce a machine that may be operated with the least consumption of steam and requiring the smallest amount of attention. These lighting outfits are made in outputs equivalent to from 25 to 500 incandescent lights, and in plants where steam boilers are in use for other purposes it is stated that light can be furnished by one of these outfits cheaper than current for the same amount of light could be purchased from service mains.

The general features of these outfits, as pointed out by the manufacturers, are compactness, perfection of mechanism and durability, reliability, freedom from vibration and low first cost. All of the principal bearings are oiled from one source of supply, and as the

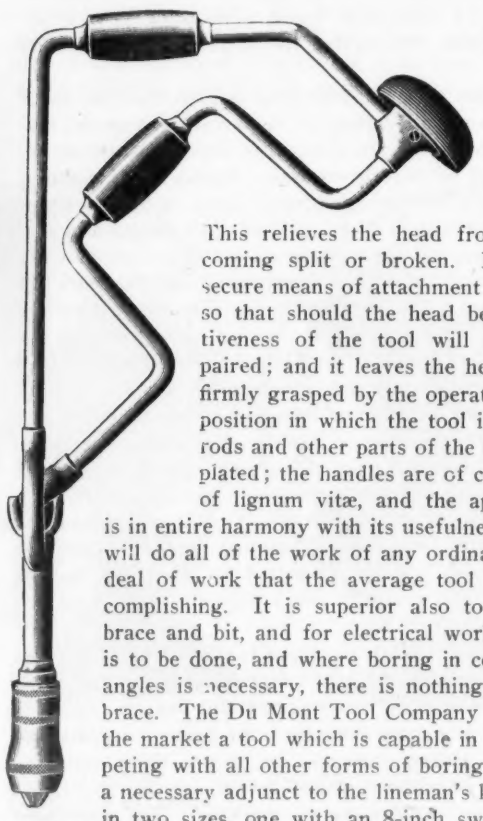


DIRECT-CONNECTED OUTFIT.

connecting rod is enclosed there is no spattering of the lubricant. The armature is said to run cool, even when considerably overloaded. The engines for the direct-connected units are constructed with short stroke and relatively large diameter of cylinder. This design gives an outfit that is at once economical and adapted for marine use.

Corner Brace for Electrical Wiring.

The Du Mont Tool Company, Buffalo, N. Y., has brought out a corner brace for which it is stated there is a large demand because of its particular adaptability to electrical work. The new style consists of a malleable iron socket in which the end of the sweep or crank turns and to which the head is secured. This relieves the head from the danger of becoming split or broken. It forms a rigid and secure means of attachment for the angular frame so that should the head become split, the effectiveness of the tool will not be seriously impaired; and it leaves the head entirely free to be firmly grasped by the operator, irrespective of the position in which the tool is operated. The steel rods and other parts of the tool are heavily nickel plated; the handles are of cocobola and the heads of lignum vitæ, and the appearance of the tool is in entire harmony with its usefulness. This corner brace will do all of the work of any ordinary brace, and a great deal of work that the average tool is not capable of accomplishing. It is superior also to the ratchet form of brace and bit, and for electrical work where much boring is to be done, and where boring in corners or at awkward angles is necessary, there is nothing so good as a corner brace. The Du Mont Tool Company claims to have put on the market a tool which is capable in every respect of competing with all other forms of boring tools, and is in itself a necessary adjunct to the lineman's kit. The tool is made in two sizes, one with an 8-inch sweep, measuring 22 by 12 by 6 inches, while the other is a 10-inch sweep, measuring 23 by 13 by 6 inches.



CORNER BRACE.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money during the week ranged between 1¼ and 2 per cent, most of the loans being made at the latter figure. Time money was higher, the rates being 3½ per cent for 30 to 90 days; 3¾ per cent for four months and 4 per cent for six months. The rates for prime indorsed bills-receivable closed at 3¾ per cent. In the stock market, speculation was quieter. Sales of speculative holdings, induced by the lack of further deals, reacted on railroad share values; the uncertainty regarding the steel combination also contributed to check activity. Steel stocks and other industrials showed some strength, but afterwards reacted. Public interest in the general market seems to have diminished, and the professional interest is of a bearish nature. With one exception, the electric and traction securities have partaken of the general quietness, the exception being General Electric. This stock closed with a net gain of 2 points, the only gain in the list. The sales were less than half of what they were the week previous, being 6550 shares, but the price reached 218. The quotations at no time during the week fell as low as 200, the lowest figure being 204. It is interesting to note that this stock has in three weeks made a net gain of 22½ points. The remarkable speculative outburst in Western Union, which was noted in last week's issue, has subsided, the reaction last week more than offsetting the gain of the previous week. It closed with a net loss of 2¼ points—¼ of a point less than the gain of the week before. Prices kept fairly steady, however, fluctuating between 88⅝ and 86¾; the sales were 18,680, as against 112,340 shares the week previous. Metropolitan Street Railway kept quite steady throughout the week, the sales and prices being about normal, the stock closing with a net loss of ½ point. The same may be said with reference to Brooklyn Rapid Transit, which lost ⅜ of a point on the week's transactions. The following are the closing quotations:

NEW YORK.

	Feb. 16.	Mar. 2.		Feb. 16.	Mar. 2.
Gen. Electric	211	213	Elec. Veh.	15	14½
Bklyn Rap. Tran.	77⅛	76¾	Elec. Veh., pfd.	30	30
Met. St. Ry.	163⅜	162⅞	Gen. Car.	2⅛	2¾
Am. Tel. & C.	97	—	Ill. Elec. Veh. Tran.	¾	¾
West. Un. Tel.	89	86¾	Hud. Riv. Tel.	120	117
Am. Dist. Tel.	36	35	N. E. Elec. Veh. Tran.	3	—
Com. Cable	160	—	N. Y. Elec. Veh. Tran.	4½	4½
Elec. Boat.	27	24	Tel. & Tel. Co. of Am.	4	4
Elec. Boat, pfd.	52	52	N. Y. & N. J. Tel.	174	175

BOSTON.

	Feb. 16.	Mar. 2.		Feb. 16.	Mar. 2.
New Eng. Tel.	—	—	Erie Tel.	*62	57
Mex. Tel.	2½	2⅝	Gen. Elec., pfd.	160	175
Westing. Elec.	—	60	Am. Tel. & Tel.	162	161
Westing. Elec., pfd.	—	—	Boston Elec. Light.	210	212

PHILADELPHIA.

	Feb. 16.	Mar. 2.		Feb. 16.	Mar. 2.
Elec. Stor. Bat.	70	68	Phil. Elec.	7⅜	6¼
Elec. Stor. Bat., pfd.	75	68	Pa. Elec. Veh.	2	—
Elec. Co. of Am.	8⅞	—	Pa. Elec. Veh., pfd.	1	—
Gen. Elec. Auto.	—	—	Am. Rys.	35½	—

CHICAGO.

	Feb. 16.	Mar. 2.		Feb. 16.	Mar. 2.
Chicago Edison	150	150	Chicago Telep. Co.	260	260
Chic. City Ry.	256	255	Union Traction	12	13¾
Nat'l Carbon	18	17	Union Traction, pfd.	55	53
Nat'l Carbon, pfd.	83	83	Northwest. Elev. Com.	33	34

* Asked.

TROLLEYS IN OHIO.—The Cincinnati Traction Company has at last been incorporated, with a capital stock of $2,000,000. It was organized for the purpose of leasing and operating the entire street railway system of Cincinnati, now controlled by the Consolidated Company. The incorporators are: Randall Morgan, Philadelphia; W. C. McGowan, Philadelphia; Jacob C. Schmidlapp, Cincinnati; William T. Irving, Cincinnati; and Charles T. Prior, Cincinnati. For the first year the new company is to pay the Consolidated 5¼ per cent on its capital stock, 5½ per cent the second year, 5¾ per cent the third year, 6 per cent the fourth year, and 6 per cent each year thereafter, during the lease. An ordinance to extend the franchises of the Little Consolidated Street Railway for 25 years has been introduced in the City Council. It provides for six tickets for a quarter for 12 years, and seven tickets for the remaining 13, universal transfers, when the rival company, the "Big" consolidated, agrees thereto, and a percentage of the gross receipts for the city, as follows: Two per cent for eight years, 3 per cent for five, 4 per cent for five, and 5 per cent for the last five years. Use of tracks by suburban lines must also be granted. At the annual meeting of the Northern Ohio Traction Company, of Akron, E. W. Moore was elected president to succeed Henry A. Everett. The past year has been one of prosperity for the company. The capital stock will be raised from $2,000,000 to $2,500,000. The construction of electric lines to Canton and Rowena was decided upon. The gross earnings for the past calendar year were $425,890. In the fiscal year ending last June, they were $388,059.

NATIONAL CARBON.—The National Carbon Company reports as follows for the year ended Jan. 31, 1901:

	1901.	1900.	Changes.
Net earnings	$508,739	$451,687	Inc. $57,052
Pref. divs	315,000	315,000	.....
Balance	$193,739	$136,687	Inc. $57,052
Depreciation	151,456	100,742	Inc. 50,714
Surplus	$42,283	$35,945	Inc. $6,338

President Parmelee says that the business of the first year has shown a steady and gratifying increase in all of its branches, except that of molded carbons for open-air lamps, which is made up of gains in another class of carbons. The remarkable growth of the telephone business has increased the business in batteries and telephone specialties to a very great extent. About $67,000 have been expended on the company's plant out of earnings. The company has no bonded floating indebtedness.

TELEPHONY IN THE SOUTH.—It is stated by the *Boston News Bureau* that the Southern Bell Telephone Company (owned by the Western Union Telegraph Company and the American Telephone & Telegraph Company, the latter owning a control), operating 70 exchanges and a valuable long distance system in Virginia, West Virginia, North Carolina, South Carolina, Georgia, Alabama and Florida, contemplates an extensive development this year to head off competition which exists quite extensively in Virginia, Georgia, Alabama and Florida. All important points will be connected with the long distance service which may be extended into Florida to meet the contemplated Cuban connection. The East Tennessee Telephone Company, operating under the Bell franchises 40 exchanges in Tennessee, has passed into the hands of the Cumberland Telephone Company (40 per cent of the stock of this company being owned by the American Telephone & Telegraph Company and 11 per cent by the Western Electric Company.) The capital stock of the East Tennessee Telephone Company is $300,000. Bonds $200,000.

CANADIAN GENERAL ELECTRIC COMPANY.—The annual meeting of the Canadian General Electric Company, of Toronto, Ont., was held on Feb. 20. The report showed that the net profits on operating accounts amounted to $262,903, and the premiums on the new stock to $75,000. These items, with the $58,437 balance from last year, making a total of $396,340. The dividends, 10 per cent on the common stock and 6 per cent on the preferred stock, amounted to $127,623; $125,000 has been added to the reserve, making that fund now $265,000, and a further sum of $12,600 has been placed at the credit of profit and loss, making $71,038 carried forward. The prospects for the new year, it was stated, were excellent. Directors were elected as follows: W. R. Brock, president; H. P. Dwight and Frederic Nicholls, vice-presidents, with the latter as the managing director.

WESTINGHOUSE STOCK.—At a special meeting of the stockholders of the Westinghouse Electric & Manufacturing Company, at Pittsburg, on Feb. 20, a vote was passed for an increase of several million dollars in the capital stock. The plan of the directors is to issue the new stock as second preferred or assenting stock. The outstanding stock of the company at present is $3,996,750 preferred, $8,227,476 second preferred, and $146,700 common stock. It was decided to make the new issue $10,000,000, of which $3,000,000 will be put out. The total authorized stock is now $25,000,000. The company shows a surplus of $4,693,000.

KETTLE RIVER POWER.—A company, called the Kettle River Power Company, has been incorporated in London, England, with a capital of $1,000,000, to acquire the rights of the Cascade Water Power & Light Company, of British Columbia, and to adopt an agreement with the London & British Gold Fields Company. The last-named company has, for some time, been doing preliminary work to develop the water power of Kettle River at the falls, Cascade City, and it is the intention to supply power and light to towns, mines, etc., throughout the boundary country.

TWIN CITY RAPID TRANSIT, of Minneapolis and St. Paul, reports $2,839,355 gross for the year, net $1,534,666, charges $1,279,075, including dividends on common stock, and $255,591 surplus. During the year the company reported uniformly steady increases in earnings, no month having shown a loss. During the year interest on funded debt was reduced 4.16 per cent. The surplus applicable to common stock dividends is equivalent to 4.90 per cent on common stock on which was paid 3 per cent in 1900 and 2½ per cent in 1899.

Commercial Intelligence.

THE WEEK IN TRADE.—Viewed as a whole, trade showed some expansion last week in spite of the tendency of severe weather to check it at some Northern and Western markets, and in face of the unsatisfactory conditions in cotton manufacturing, brought about by dullness in cotton goods at first hands. *Bradstreet's* points out that iron and steel in the cruder forms have been very strong at central and Eastern markets, and considerable advances are reported in pig iron and steel billets. Building material showed notable strength. Reports from many cities indicate that a large amount of building will be done during the spring. The relatively best trade advices come from the Central West and the Southwest. Export trade in iron and steel is slack, foreign markets are steadily going lower and the fear of discriminating duties against American iron and steel is evident, although the first manifestation, that in the case of Russia, involves a small amount of business. Weather conditions were unusually favorable to the railways, and returns for the second week of February are likely to be even better than those for the first week, which were 6.4 per cent better than a year ago. The business failures for the week, as reported by *Bradstreet's*, were 221, as against 226 the week before; 168 in the same week last year and 220 in 1899. In the metal market copper was unchanged, little buying being done, particularly in large lots. The tone, however, is a trifle stronger. Lake Superior ingot is quoted at 17 cents, and electrolytic and casting stock at 16⅝ cents. The exports of copper for the first three weeks of February do not show up well. It is estimated that they were below 5000 tons, while last year the total for the month was 13,653 tons.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended Feb. 20: Antwerp—15 packages electrical machinery, $250; 51 packages electrical material, $11,317. Argentine Republic—30 packages electrical material, $1,088; 1 package electrical machinery, $200. Brussels—8 packages electrical material, $178. British Australia—32 packages electrical material, $1,033; 5 packages electrical machinery, $1,004. British Guiana—19 packages electrical material, $399. British East Indies—2751 packages electrical machinery, $301,350; 9 packages electrical material, $485; 9 cases motor vehicles, $713. Bradford—95 packages motor trucks, $6,525. Bremen—3 cases electrical material, $1,082. Bristol—2 crates trolley wagons, $263; 38 cases electrical material, $3,540. Brazil—46 packages electrical material, $2,708; 65 packages electric railroad material, $2,688. British West Indies—3 packages electrical material, $75. Copenhagen—1 package electrical machinery, $30. Chili—4 cases electrical material, $60. Central America—21 cases electrical material, $373. Cuba—29 cases electrical material, $398; 1 crate auto vehicles, $300. Christiania—1 package electrical machinery, $89. Danish West Indies—1 package electrical material, $8. Dutch West Indies—2 packages electrical material, $70. Ecuador—6 packages electrical material, $200. Glasgow—118 packages electrical machinery, $17,286; 10 packages electrical material, $297; 56 reels electric cable, $20,873. Gibraltar—6 packages electrical material, $1,300. Hayti—1 case electrical material, $17; 130 packages electrical machinery, $15,339; 46 packages electrical material, $2,750. Ipswich—18 cases electrical material, $2,500. London—208 packages electrical machinery, $4,185; 128 packages electrical material, $8,037; 7 cases motor vehicles, $5,000. Liverpool—13 cases electrical machinery, $2,750; 11 packages electrical material, $400. Manchester—3 packages electrical material, $300. Mexico—224 cases electrical material, $4,844; 9 packages electrical machinery, $5,000. Newcastle—8 cases electrical machinery, $1,600; 37 packages electrical material, $5,583. Odessa—26 cases electrical material, $290. Rotterdam—1 case motors, $52. Southampton—2 cases electrical material, $132. Trieste—1 case electrical material, $75; 3 cases motor vehicles, $850. Vienna—3 cases electrical material, $231. Venezuela—62 cases electrical material, $988.

ELECTRICAL APPARATUS IN BRAZIL.—Discussing the work of the General Electric Company in foreign countries and in Brazil, the *Brazilian Review*, an English publication, says: "The most important works executed here are the Jardin Botanico, Tijúca and Santa Thereza tramways and the light and power station on the Tieté; a number of smaller lighting installations all over the country, at Bello Horisonte, Manáos, Petropolis, Juiz de Fóra, São João del Rei, Piracicaba, Jacaréhy, Cravinhos and Bagé, in addition to a number in this city. From Manáos to Rio Grande do Sul, the country is an evidence to American skill and enterprise in this particular branch. What steam was to this century electricity will be to the next. The race to-day is to the swift even more than to the strong, and unless the English wake up and apply their energies and capital betime to the substitution of steam by electricity they will inevitably fall out of the race altogether. It was steam and the development of steam power the world over that enriched England and made her so powerful abroad; will Englishmen be content to see their place taken by Americans without a struggle, and sink to the state of Spain, to be a discontented island in the German Ocean. Those who run may read from Dan to Bersheba the signs and portents crying aloud: Awake, awake, or be forever fallen!"

THE CROCKER-WHEELER COMPANY, Ampere, N. J., report the following sales for month ending Feb. 15: Direct-connected generators to Schwartzchild & Sulzberger, two 250 kw; United States Mint, Philadelphia, Pa., two 200 kw, one 150 kw, one 75 kw; Brown Shoe Company, St. Louis, Mo., one 200 kw; Hahne & Co., Newark, N. J., two 200 kw, one 100 kw; E. I. Du Pont de Nemours, Wilmington, Del., one 200 kw; Navy Yard, Washington, D. C., two 150 kw; National Electric Supply Company, Washington, D. C., one 50 kw; Bement, Miles & Co., Philadelphia, Pa., one 50 kw; Toledo Bridge Company, Toledo, Ohio, one 50 kw; White Star Line, one 50 kw. In addition to these, the following motors have been sold: To Philadelphia Engineering Works, Philadelphia, Pa., 46 motors, aggregating over 700 hp. This makes upwards of 3000 hp already sold to that company. Pencoyd Iron Works, four motors, aggregating 60 hp, making over 4000 hp already sold to them. Schwartzchild & Sulzberger, two 75 hp, two 50 hp, seven 25 hp, 14 motors aggregating 160 hp, in addition to 500 hp already sold to them. Various smaller sizes of motors have been sold: To the Link Belt Machine Company, Philadelphia, Pa.; Howard Iron Works, Buffalo, N. Y.; Maris Bros., Philadelphia, Pa.; Richmond Locomotive & Machine Works, Richmond, Va.; National Tube Works, McKeesport, Pa.; Kansas City Electrical Manufacturing Company; Armour & Co., Chicago, Ill., who have already bought over 1300-hp motors and generators; New York Ship Building Company, Monesen, Pa.; Hilles & Jones, Wilmington, Del.

UTILIZING THE SUSQUEHANNA.—The proposition to generate electricity on the Susquehanna River and transmit it to Philadelphia and Baltimore, which is being worked out by Baltimore interests, has not yet reached a stage to permit of a statement as to when actual work on the project will be begun. The Susquehanna Electric Power Company, formed by the promoters of the plan, has $12,000,000 capital. At the start an issue of $4,000,000 bonds is contemplated from an authorized issue of $8,000,000. The Susquehanna Electric Power Company has purchased rights-of-way and water privileges on the Susquehanna River. The first development is to be near Peach Bottom, Pa., and is to be 40,000 horse-power. A contract has been made with the United Railways & Electric Company, of Baltimore, for 40 years to take 20,000 horse-power. Mr. S. Davies Warfield, president of the Continental Trust Company, of Baltimore, is working out the details of the project. All the engineering work has been done. Alexander Brown & Sons made the preliminary plans, which are now in the hands of the trust company.

ORDERS FOR BULLOCK APPARATUS.—Among the foreign orders received recently by the Bullock Electric Manufacturing Company, of Cincinnati, are one 30-hp teaser equipment for the *Aberdeen Journal*, Aberdeen, Scotland; three motor-generators for the *London Daily Express*, and three motor-generators for the *Glasgow Evening News*, Glasgow, Scotland. The Bullock Company has also sold to the Montreal Water & Power Company, Montreal, Canada, one 400-hp three-phase motor; the Carnegie Steel Company, one 25-hp three-phase motor (the fifth or sixth order from that concern); Greumer & Co., Johnstown, Pa., one 30-kw ("I.") engine-type generator; Brown & Sharpe, Providence, R. I., four type N motors; Weir Frog Company, Cincinnati, one 10-hp type N. generator and two special motors; the Pullman Company, Pullman, Ill., two 150-kw type H generators; Mosler Safe Company, one 50-hp motor, type H; Susquehanna Valley Electric Type Company, Sydney, N. Y., one 65-kw single-phase alternator, and the Central Lard Company, New York, one 65-hp engine type generator.

EXHAUST FANS FOR RUSSIA.—President J. B. Dill, of the Specialty Manufacturing Company, of Indianapolis, writes us as follows: "We wish to enter a protest against the American and Russian entanglement. We this morning received an order from a Russian city for 18 Triumph exhaust fans, belted-fans running from 18 in. to 42 in. diameter. Now, this order you well know cannot be filled, it being dated Feb. 9, this being previous to the Russian edict against the United States. Now, this is just what we have been paying you our money for, and so far as Russia is concerned our money and efforts avail nothing. We hope that every effort will be made to settle this matter, so the business of this country can proceed without interruption, and it behooves you people and every merchant and manufacturer to act energetically and promptly in this matter." It seems to us that Mr. Dill, as he says, has a good incentive to do active work of the kind he suggests so vigorously.

JOHN STEPHENSON & CO.'S AFFAIRS.—Creditors of the John Stephenson Company, Limited, street car builders, now in liquidation, met at the office of Sullivan & Cromwell, the attorneys for the receiver, last week. A statement showing the condition of the firm gave the liabilities as $488,000, and assets in this State, $34,000, and the assets in New Jersey, $176,000. The concern is expected to pay from 30 to 33 cents on the dollar.

NEW RAPID TRANSIT CONTRACT.—The contract for the rapid transit tunnel section in Forty-second Street and Broadway, New York City, has been awarded to the Degnon-McLean Construction Company, which has also the contract for building that part of the road between City Hall Park and Great Jones Street. The Forty-second Street section was awarded several weeks ago to Benezette Williams, a Chicago engineer, but some complications arose and Mr. Williams failed to qualify. The Degnon-McLean Company has already begun preliminary work in Forty-second Street, and before long the thoroughfare will again be torn up. The work will require a large force of men, and, although the strip is one of the most difficult to handle along the entire route, the contractor says he expects to finish it on time.

AMERICAN ELECTRIC PLANT IN INDIA.—Consul Fee reports from Bombay, Jan. 10, 1901, that the steamship Buceros, sailing direct from the port of New York, has arrived with an electric plant and outfit and a party of engineers and electricians, representing the General Electric Company, of New York, and destined for the Kolar gold fields, near Bangalore, the capital of the native state of Mysore. The Cauvery River, adds Mr. Fee, is to be used as the source of generating the electric power, which will be conducted across the country to the Kolar gold fields. It is expected that this new power will increase the production of the mines and also lessen the cost of working. This plan is attracting considerable attention, not only from the fact that it is American, but also because it is a new departure in gold mining in India.

TROLLEY CONTRACTS.—It is stated that contracts to complete Mr. Tom Johnson's trolley road from Philadelphia to New York have been awarded to Craig & Fell, railroad contractors at Trenton, and the line is expected to be in operation by June. Mr. Johnson already has a complete line in operation from Philadelphia to Lawrenceville, N. J. The new contract is for building the road from Lawrenceville to New York, and work will be begun immediately. The service between the two cities will be express time, and the cars will be heavy, with double trucks, geared for unusually high speed. The terminal at Philadelphia will be at Frankford, at which point connection with the center of the city will be made over the Fifth and Sixth Street line.

ELECTRIC TRACTION IN GREAT BRITAIN.—The Tramways Department of Brighton will shortly install a duplicate power plant at the North Road electricity works. The equipment will include engines, dynamos, switchboard complete, steam apparatus, boilers, etc. Extensions and improvements will be made on the tramways systems of Derby and Shipley, for which adequate sums of money will be borrowed by the corporations. An electric railway is to be built between Middletown and Ballycotton, near Cork, Ireland, at a cost of about $250,000. It is stated that the Irish Electric Railway Company will complete a line from Kenmare to Bantry, to cost in the neighborhood of $3,500,000.

THE VAN DORN-ELLIOTT ELECTRICAL COMPANY, of Cleveland, has been incorporated by J. H. Van Dorn, H. H. Hodell, F. Schneider, W. A. Dutton and W. H. Elliott. Capital stock, $50,000. The new company takes over the electrical repair, armature winding and manufacturing business heretofore carried on by Van Dorn & Dutton, also the electrical repair business carried on by W. H. Elliott, of that city. The gear manufacturing business carried on by Van Dorn & Dutton will be continued as heretofore under the old name. The new company will occupy a portion of the Van Dorn & Dutton plant. J. H. Van Dorn will be president.

TROLLEY CARS FOR RUSSIA.—In a communication to the State Department Consul-General Holloway at St. Petersburg says that the municipality of that city, which at present has three of the car lines under its control, anticipates the possession of the remaining lines before March 1, when the authorities will advertise in the leading newspapers of the world for bids for the conversion of the lines to the electrical system. The underground system will be used in the center of the city, and the overhead trolley in the outskirts. The present lines are single track. The fare is about three cents for inside seats and about two cents for outside or top seats.

MR. FRANCIS E. RAINEY, of London, England, representing a big importing company of that city, and dealing in American-made machinery, was one of a party of capitalists and manufacturers who spent 10 days early in February touring Southern cities. Mr. Rainey is impressed with some new American types of machinery for electrical power transmission, and will purchase some motors and generators ere his return to his home. The visitor was also impressed with the growing evidences of appreciation of electrical transmission as seen in the South.

THE SEOUL ELECTRIC COMPANY, Corea, which concern operates the first electric traction system in that part of the world, is placing some substantial contracts for additional equipment for its generating station as well as making fair-sized purchases for cars, etc. The General Electric Company is furnishing a number of rotary transformers and car equipments, while the J. G. Brill Manufacturing Company, of Philadelphia, is to ship some half dozen cars. The orders are being obtained through Frazar & Co., of Japan, whose New York offices are at 63 and 65 Wall Street.

AN ENGLISH ELECTRICAL SUPPLY COMPANY, situated in Birmingham, wishes to open up correspondence with American manufacturers of electric accessories. The request is made by Consul Marshall Halstead that letters, catalogues, circulars, etc., be addressed to him, and he will pass them on to the supply company in question. Letters should be addressed to Electric Supply Company, in care of the Hon. Marshall Halstead, Consulate of the United States, Birmingham, England.

ELECTRIC LIGHTING IN HOLLAND.—The Commercial Council at The Hague, Holland, is advertising for a contract for the erection and equipment of an electric plant for the lighting of the city. The contract closes March 25. The supply and installation of the complete central station plant for the Municipal Electricity Works, of Amsterdam, Holland, is now being advertised for. The contract closes April 1, and particulars of the same can be obtained of the secretary, Achtenburgwal, Amsterdam.

TRACTION CONTRACTS.—The corporation of Bournemouth, Eng., is asking for tenders and specifications for the supply of 42 electric cars. The forms of the tender and specifications can be obtained by addressing F. W. Lacey, Borough Engineer, Bouremouth. The contracts close March 2 and a deposit of $250 must accompany each tender, which will be returned to those whose tenders are not accepted.

EXPORTS OF ENGINES.—Recent export shipments of the Ball Engine Company, Erie, Pa., are: One 40-hp simple engine, one 75-hp compound direct connected engine, to Japan; two 125-hp tandem compound engines to Russia; one 50-hp simple engine to Honolulu, H. I.; one 60-hp direct connected engine to Vera Cruz, Mexico; one 150-hp cross compound engine to British Columbia, and one 400-hp direct connected engine to England.

NEW POWER-HOUSE PLANS FILED.—George H. Pegram, chief engineer for the Manhattan Railway Company, New York City, has filed plans for a new two and three-story brick station, to be used for storing and distributing electric power for the new third-rail system with which the elevated road is to be equipped. The station will be erected on the west side of Third Avenue, 33 ft. north of 161st Street, at a cost of $31,000.

BALL ENGINE CONTRACTS.—The P. R. Mitchell Company, Cincinnati, Ohio, is installing an electric power plant, the engine, which is 175-hp, self-oiling type, being furnished by the Ball Engine Company, Erie, Pa., which is also installing five 300-hp self-oiling engines in the new electric light plant of the Lacombe Electric Light Company, at Denver, Colo.

M. OSHIMA, Director-General of the Imperial Government Steel Works of Japan, has arrived from Europe with a view to placing some important contracts for electrical equipment for his plant, which is the largest in the Far East. He left New York last Tuesday for the West, where he will visit the principal industrial centers. His visit will be about a month's duration.

RUSSIAN SUGAR.—The National Association of Manufacturers has taken up the subject of the countervailing duty on Russian sugar and the Russian retaliatory duties on American machinery, and is moving to have the United States Government rescind its action.

ENLARGEMENT OF PLANT.—The Cincinnati Edison Electric Company has ordered new dynamos and engines of a capacity equivalent to about 80,000 lights. Much outside construction will be necessary, both overhead and underground. The new work will be completed during the summer.

ELECTRIC METERS.—The Corporation of Launceston, Tasmania, is advertising for 500 electric meters. The contract will be closed on April 22 next. Specification, etc., may be obtained from John Terry & Co., 7 Great Winchester Street, London. Mr. William Corrin is the city electrical engineer of Launceston.

ELECTRIC CRANES FOR ENGLAND.—It is announced that the Ship Canal Warehouse Company, of Manchester, England, desires to receive bids on 22 electric jib cranes, and foreign tenders are invited.

MUNICIPAL PLANT EQUIPMENT.—Mr. S. C. Lancaster, city engineer of Jackson, Tenn., is in the market for an engine and a boiler of 125 hp and a 200-hp condenser, together with other apparatus for a municipal lighting plant.

STOKERS.—Westinghouse, Church, Kerr & Co. have been awarded the contract for Roney mechanical stokers at the new Waterside station of the New York Gas & Electric Light, Heat & Power Company. The order calls for 32,000 hp.

NEW SOUTH WALES.—The American Bridge Company has received a contract for the steel work for the electric power plant to go to Ultimo, New South Wales, Australia.

General News.

THE TELEPHONE.

CADOTT, WIS.—The local telephone company has been granted franchises to place exchanges in Boyd and Stanley.

SANDUSKY, OHIO.—The Sandusky Telephone Company has installed 200 new telephones during the past month.

GRAND RAPIDS, WIS.—The Wood County Toll Line Company will extend its telephone line to Babcock from Pittsville, a distance of eight miles.

FINDLAY, OHIO.—The Findlay Home Telephone Company has secured a franchise to install an exchange in the neighboring village of Benton Ridge.

GALLIPOLIS, OHIO.—The Gallipolis Telephone Company has increased its capital stock from $30,000 to $50,000. F. M. Bow is secretary of the company.

MONTGOMERY CITY, MO.—The People's Telephone Company has been incorporated with a capital of $3,100 by H. Ellis of New Florence and T. Marlow of Americus.

NEW LONDON, OHIO.—The Tri-County Telephone Company of this city has been incorporated with $25,000 capital stock, to operate exchanges in New London and Greenwich.

LEXINGTON, KY.—The Fayette Home Telephone Company has been incorporated with a capital of $25,000 by J. R. Allen, T. W. Bullock, J. H. Shouse, Chas. Kerr and L. G. Coe.

ALBANY, N. Y.—The Genesee Valley Telephone Company, of Rochester, has been incorporated; capital, $100,000. Directors: J. Foster Warner, G. R. Fuller and E. M. Higgins, Rochester.

LADOGA, IND.—The Ladoga Telephone Company uses apparatus of the Electric Appliance Company, has a 100-drop board and 69 subscribers, with a large expected increase in number.

ST. CHARLES, MO.—The Kinloch Telephone Company has its toll exchange completed and the line is now ready for use between St. Louis and St. Charles. The local exchange will be completed by April 1.

ASHLAND, KY.—The Hanover & Henrico Telephone & Telegraph Company has been chartered with capital stock of $5,000, by W. C. Saunders, E. S. Campbell, M. D. Hart, E. L. C. Scott and John G. Pollard.

RICHMOND, VA.—The Long Distance Telephone Company of Richmond will soon have a number of important cities of Virginia connected, among them Staunton, Roanoke, Lexington, Lynchburg and Harrisonburg.

MURPHYSBORO, ILL.—The Southern Illinois Telephone Association held a conference in this city Feb. 15 and decided to accept a proposition to make telephone connection with St. Louis, but whether with the Bell or Kinloch Company has not yet been determined.

NEWTON FALLS, OHIO.—The Newton Falls Telephone Company has elected directors as follows: C. M. Rice, C. E. Fenton, F. W. Corey, H. H. Porter and C. E. Gardner. Arrangements have been made to connect with the Garrettsville and Ravenna exchanges.

HIGHER WAGES.—General Manager C. E. Schaff, of the Big Four Railroad system, has issued an order advancing the salary of every telegraph operator in the employ of the road 12½ per cent. The change will affect between 700 and 900 men, and will increase the pay-roll of the company about $100,000 yearly.

ST. LOUIS, MO.—Stockholders of the Bell Telephone Company of Missouri have re-elected the old officers and directors, with the following exceptions: Alexander Cochran was elected president to fill the vacancy caused by the death of John E. Hudson, and P. C. Moffett director to fill the vacancy caused by the death of C. C. Moffett. Edwards Whitaker was chosen vice-president.

ROCHESTER, N. Y.—Hearings have been had before a referee in the action on the part of the city to force the local Bell Telephone Company to put its wires into the conduits of the Gas & Electric Company. The telephone people have objected, alleging that it is not safe to put their circuits into such proximity to the high tension light and power circuits. The dispute is being actively fought out.

CHARLOTTE, N. C.—The Queen City Telephone Company of this city has gone into the hands of a receiver. The amount of the failure is $28,000. Dr. J. F. Robertson has been appointed receiver and the plant will be sold March 18. Capt. J. H. Wiley, of Salisbury, N. C., is president of the company and J. A. Helvin general manager.

TUB, PA.—The Mutual Telephone Company has a 10-drop switchboard, and the exchange is wired for 20. Its party lines run through the county. The company has 100 subscribers, 25 of whom were added during the last year. The apparatus of the Keystone Telephone Company and that of other companies is used. The company is contemplating building a line about 15 miles long. G. D. Miller is manager.

FORT MARION, PA.—The Farmers' Telephone Company was organized during the past year. It hopes to reach Pittsburg shortly by way of the lines of the Tri-State Company. The business office of the company is Van Voorhis, W. Va. The company has a 50-drop switchboard and 60 subscribers, using American Company apparatus. Mr. E. J. Moore, with headquarters at Van Voorhis, W. Va., is secretary of the company.

INDIANAPOLIS, IND.—A bill of much interest and concern to telephone companies is pending in the Legislature. It provides for maximum charges for long-distance telephone companies. The distances are divided into 10 classes, and a maximum charge for each class is made, which is about one-half less than now charged. The Central Union and New Telephone companies have combined and are presenting a powerful lobby against the passage of the bill.

NOBLESVILLE, IND.—A telephone rate war has been inaugurated in this city. The Central Union Company announced that it would give free communication to its subscribers with every town in the county, and offers the same privileges to farmers having telephones placed in their homes. A rate of 50 cents a month has been made for residence and a 10-cent rate between this city and Indianapolis. The other companies will meet the competition. The cutting on the part of the Central Union is said to be due to the fact that the new company, which recently established a plant in this city, is getting the lion's share of the business.

CLEVELAND, OHIO.—The Everett interests of this city have secured an option on the telephone franchise secured a short time ago from the city of Detroit, Mich., by J. W. Martin. It is stated, however, that the Cleveland people are unwilling to build the Detroit exchange on the exact terms mentioned in the Martin franchise, as it is claimed the rates offered are too low. The Everett interests already control the independent long-distance lines in Michigan, as well as a number of the most important exchanges in that State, so that the Detroit exchange would be a great acquisition. If Mr. Martin can secure the desired amendments to the franchise the deal will probably be closed in the near future.

ELECTRIC LIGHT AND POWER.

TAMPA, FLA.—The city contemplates erecting a lighting plant.

LIVE OAK, FLA.—C. Y. Byrd will establish an electric light plant.

VALDOSTA, FLA.—C. Y. Byrd, of Live Oak, Fla., will erect an electric light plant.

PINE BLUFF, ARK.—The Bluff City Lumber Company has applied for a lighting franchise.

NORFOLK, W. VA.—The Norfolk Light, Heat & Power Company is to build a large power plant.

TULLAHOMA, TENN.—The establishment of electric light plant and water works is contemplated.

ELLISVILLE, MISS.—The city will issue $15,000 of bonds for the erection of an electric light plant.

WINCHESTER, TENN.—The city is investigating the cost of constructing electric light and water plants.

HAMPTON, VA.—A committee will be appointed to investigate the advisability of erecting an electric light plant.

SOMERVILLE, TENN.—The city will issue bonds for the erection of an electric plant and construction of water works.

KANSAS CITY, MO.—The Spring River Electric Power Company has been incorporated with a capital stock of $50,000.

TITUSVILLE, PA.—The Titusville Iron Company has added to its boiler department and put an electric traveling crane in it.

TARENTUM, PA.—The Allegheny Steel & Iron Company is putting in two gas engines of 150 and 100 horse-power for electric lighting in its new sheet plant.

CANTON, GA.—Capt. T. M. Brady will install an electric plant for lighting his marble works, and probably install a plant large enough for lighting the town.

HUNTINGTON, ARK.—The Huntington Electric Light & Power Company has been incorporated, with capital of $8,000, by Wm. Harper, J. H. Thompson, H. Mayer, H. F. Rogers and others.

NILES, OHIO.—The Niles Boiler Company has closed contracts for a 125-hp engine, a 100-hp generator, seven electric motors, and these, with two 100-hp boilers, will be at once installed in a new power house.

COLUMBUS, GA.—The Columbus Power Company is harnessing the Chattahoochee River in the outskirts of the city at the base of a 150-ft. fall. Present outlined operations will entail an expenditure of $300,000.

FAIRFAX C. H., VA.—The Southern Incandescent Lighting Company, of Virginia, has been chartered, with R. C. L. Moncure, president, and James P. Machen, Jr., secretary and treasurer; capital stock, $5,000.

WILMINGTON, N. C.—The House Committee has reported favorably on bills to charter the Yadkin Falls Electric Company, the Clinton & Dunn Telephone Company and the electric railway from Asheville to Weaverville.

CINCINNATI, OHIO.—The Cincinnati Edison Electric Company, which has the contract for city lighting, is arranging to make gas in case the city decides to adopt that system at the expiration of the contract, two years hence.

GALION, OHIO.—F. C. Gwynne, of the Delaware (Ohio) Light, Heat & Power Company, has applied for a franchise for a lighting and heating plant similar to that which has recently been placed in operation in Delaware.

NEWARK, N. J.—An order for two 200-hp and two 100-hp engines for the new department store of Hahne & Company, of Newark, N. J., has been given to the Harrisburg Foundry & Machine Company. The engines are to be coupled to Crocker-Wheeler generators.

RAVENNA, OHIO.—The Portage County Commissioners have awarded a contract to the Howe Engine Company of Indianapolis for the installation in the county infirmary buildings of an electric lighting and water supply plant. The company placed a bid of $3,690.

CINCINNATI, OHIO.—Representatives of a new company at Wise, Va., have purchased, in Cincinnati, machinery and other apparatus for an electric light and power plant at that place. W. E. Kilgore, president of the company, said operations will be commenced in 60 days.

OTTAWA, ONT.—For the past few weeks a deal has been going on at St. Catharines, Ont., which means the consolidation of the electric power and light generating establishments of the city, and ultimately placing them in the control of the Cataract Power Company of Hamilton, Ont.

MIDDLETOWN, CONN.—Wilcox, Crittenden & Company, manufacturers of castings, etc., and hardware, have installed an electric plant which is supplying the entire works with power and light. Each department has an independent motor. A new 250-hp cross compound engine is being put in.

OTTAWA, ONT.—The Stave Lake Power Company, of British Columbia, is negotiating with a view to securing certain privileges as to the construction of poles and wires. The company agrees to expend $400,000 in building dams, power houses and other works, and in transmitting power from Stave Lake to Vancouver.

HUNTINGTON, ARK.—The Huntington Electric Light & Power Company has been incorporated. The capital stock is $8,000. The incorporators are Wm. Harper, M. Hayes, J. H. Thompson, H. Mayer, H. F. Rogers, S. T. Mottley, O. B. Young, J. T. Redding, J. A. Finney, John Degen, W. W. A. Curry and H. E. Cunningham.

COLUMBUS, OHIO.—The Council committee on lighting has been instructed to have prepared detailed plans and estimates showing the cost of building, engines, boilers, generators and other necessary apparatus for a lighting plant sufficient to furnish light for the entire city. The present lighting contract will expire in a few months.

INDIANAPOLIS, IND.—The Gamewell Fire Alarm Telegraph Company of New York was the only bidder for the construction of the new electric fire alarm system for this city. The Council appropriated $65,000 for the work, and the Gamewell's bid is $63,500, with extras making the entire cost $69,700. The board has taken the bid under advisement.

CHARLESTON, S. C.—The Twin City Power Company, capital $1,000,000, has been granted the right by the House of Representatives, in a bill passed, to construct a dam across the Savannah River near Parksville, S. C. Congress has granted the same right, provided the dam will not interfere with navigation and fisheries. Samuel Saylor, of New York, and others are the incorporators.

COLUMBIA, S. C.—The State of South Carolina may install an electric plant in the public buildings here. The contract with the local electric light company expires soon. The Columbia Electric Street Railway & Power Company has, in view of the expiration of its contract, made two propositions to the State, looking either to a purchase by the State of certain machinery and power belonging to the company, or to a new contract between the company and the State.

CINCINNATI, OHIO.—Jas. C. Ernst, president of the Cincinnati, Newport & Covington Street Railway Company, has been offered the presidency of the new lighting combine backed by the North American Company, which seeks control of all the electric light and gas companies of Covington, Newport and vicinity. The acceptance is conditioned upon the taking in of all the local interests and they are permitted to control the board.

WOODSTOCK, ONT.—Although the rate payers of this city voted for the purchase the electric light plant of the town in November last, the plant has not yet been taken over. A quantity of the electric light company's bonds has been missing, and up to the present there are $2,000 worth yet to be located. These are thought to be in Ohio. If these lost bonds could be found, the city would take over the plant in twenty-four hours. It is said that the long delay may bring the matter into the courts.

CINCINNATI, OHIO.—A number of the large cotton mills of the South are changing to electrical transmission. The new mill of Capt. E. A. Smyth, at Pelzer Mills, North Carolina, has 68,000 spindles and obtains its power by electrical transmission from a point four miles distant. The only belting is from overhead shafting to looms and spindles, and the loss in transmission from point of generation to point of utilization is only 15 per cent. In Southern mills a general average of 22 per cent is lost in steam power transmission.

CINCINNATI, OHIO.—The Cincinnati Edison Electric Company has elected directors for the ensuing year as follows: George Bullock, William Nelson Cromwell, J. B. Foraker, Maurice J. Frieberg, James J. Hooker, M. E. Ingalls, A. Marcus, J. G. Schmidlapp, George P. Sheldon, C. A. Spoffard, C. W. Wetmore and Wm. F. White. The new officers are: President, George Bullock; vice-president, C. W. Wetmore; general manager, Wm. F. White; secretary and treasurer, Silas W. Burt; assistant secretary-treasurer, Alfred Knight.

BALTIMORE, MD.—All overhead wires of electric lighting, telegraph and telephone companies are to be placed in the municipal subways within seven months after the order is signed by the Mayor. The feed wires of the United Railways & Electric Company will be excepted. The companies to use the city's conduits are the United Electric Light & Power Company, Chesapeake & Potomac Telephone Company, Maryland Telegraph & Telephone Company, Postal Telegraph Company, Western Union Telegraph Company, all of the railway companies which operate wires within the subway belt, and the wires of the police and fire alarm telegraph system.

THE ELECTRIC RAILWAY.

MARION, IND.—An electric railway is proposed between Celina, Ohio, and this place.

BEDFORD, IND.—The City Council has granted a franchise to the Bedford Street Railway Company.

PINE BLUFF, ARK.—W. H. Langford is interested in a company to build an electric line in Pine Bluff and suburbs.

TIFFIN, OHIO.—The Tiffin & Southwestern Railroad Company has been incorporated with $50,000 by local people.

TUSCALOOSA, ALA.—It is reported that a number of improvements will be made to the Tuscaloosa Belt Railway Company.

NEWCASTLE, IND.—The interurban line between Anderson & Muncie and other gas-belt towns will be extended to this city.

BALTIMORE, MD.—The United Railways & Electric Company has decided to construct a branch at West Arlington, in the suburbs.

NEW HAVEN, CONN.—The power house of the Winchester Avenue Railroad Company was destroyed by fire on the morning of Feb. 16.

SAVANNAH, GA.—The Savannah Street Railway Company is considering the building of an electric line to Montgomery, in the suburbs.

COLUMBUS, OHIO.—Thomas Kerr, of Columbus, is securing right of way for an electric railway line from Columbus to Richwood by way of Dublin.

RAVENNA, OHIO.—The Northern Ohio Traction Company has asked for a city franchise which will enable it to extend its line from Kent to Ravenna.

BIRMINGHAM, ALA.—The Birmingham Railway & Electric Company will be in the market for eqipment to change its 30-mile steam line to electric, with 60-lb. rails.

OMAHA, NEB.—Fire on the night of Feb. 8 destroyed the interior of the power house of the Omaha Street Railway Company, including cars, machinery, etc. The loss is placed at $200,000.

RICHMOND, VA.—The contracts for the grading on the 40-mile electric railway between Petersburg and Richmond, Va., have been let to A. L. Phillips, H. H. George, Jr., and Carpenter Bros.

BELLEVILLE, ILL.—The differences existing between the St. Louis & Belleville Traction Company and its employees have been amicably adjusted and cars are now running on all city lines.

LAFAYETTE, IND.—The Lafayette, Purdue & Northern Traction Company has filed articles of incorporation, with a capital stock of $800,000. The board of directors is headed with James R. Rock.

KENTON, OHIO.—The Wapakoneta & Kenton Traction Company has been incorporated by W. G. Brorein, H. C. Settgage, S. A. Hoskins, J. H. Goeke and C. T. Kolter. Temporary capital stock, $5,000.

MAUMEE, OHIO.—The Toledo, Napoleon & Defiance Railway Company and the Toledo, Waterville & Southwestern Railway Company, rival projects, have submitted bids for a franchise through this place.

LAFAYETTE, IND.—The first step in a consolidation of electric railways in Southern Michigan, Northeastern Indiana and Northwestern Ohio has been taken by the purchase of the street railways of Lafayette, Ind.

NASHUA, N. H.—The Boston & Maine Railroad and a party of New Hampshire capitalists, headed by Charles Collins of this city, are both seeking a franchise for an electric railway between this city and Concord.

BROOKLYN, N. Y.—The new Flatbush depot of the Brooklyn Rapid Transit Company, which is to be erected on the site of the one recently burned, will include up-to-date club rooms for the motormen and conductors.

ELYRIA, OHIO.—The Elyria, Grafton & Southern Railway Company has been incorporated by Sumner B. Day, J. B. Faxon, George Chamberlin, Charles E. Wilson and Arthur B. Taylor. Temporary capital stock, $10,000.

WABASH, IND.—The Fort Wayne & Southwestern Electric Railway Company has secured the right of way and will extend its line from Huntington to this city. The company also expects to build a line southwest to Marion.

SEATTLE, WASH.—The Seattle-Tacoma Electric Railway now in the control of Fred E. Sander, has been granted a right-of-way along the county road in Pierce County, Wash., extending through the Puyallup Indian Reservation.

SANDUSKY, OHIO.—At a meeting held a few days ago the directors of the Sandusky, Norwalk & Southern Railway Company voted an appropriation of $50,000 for the improvement of the roadbed between Norwalk and Sandusky.

EAST LIVERPOOL, OHIO.—The East Liverpool & Rock Springs Railway Company has filed petitions in Hancock County, W. Va., asking for a franchise to extend its line from Chester to New Cumberland, a distance of 12 miles.

DANVILLE, IND.—The Western Indiana Electric Railway Company has been granted a franchise over the Rockville road by the Hendricks County Commissioners for a term of 50 years. There was strong competition for this grant.

ELKHART LAKE, WIS.—The Village Board has granted a 75-year franchise to J. M. Salmann and associates for an electric street car line. The line will be extended from Sheboygan Falls through Plymouth and Cedar Lake to this place.

KOKOMO, IND.—The Central Traction Company announces officially that all details have been arranged and ample Eastern capital secured to begin at once the construction of the electric road between this city and Indianapolis by way of Noblesville.

SPRINGFIELD, OHIO.—The Dayton, Springfield & Urbana Southwestern Railroad Company has asked for franchises on several city streets to give an entrance to the city for its proposed line to Yellow Springs, Clifton, Cedarville, Jamestown and Xenia.

BOSTON, MASS.—The Legislature has been petitioned by the Southbridge & Sturbridge Street Railway Company for the right to build extensions of that line from Fiskdale to Brimfield and Wales. This will give direct connection between Worcester and Hartford.

CRESTLINE, OHIO.—The Ohio Central Traction Company has asked for a franchise for a line from Galion to this city, and the grant will probably be given by the County Commissioners. The company has already placed contracts for rails and other materials for the extension.

CINCINNATI, OHIO.—Randall Morgan, the representative of the Weidner-Elkins-Daly-Brady combination, announces that the new interests in control of the Cincinnati Street Railway will build up an inter-urban system that will attract people to Cincinnati from every direction.

DURHAM, N. C.—The Durham Traction Company has completed arrangements for the building of its system. The gentlemen behind the company are Col. J. S. Carr and R. H. Wright of Durham, Samuel Register of Richmond, Va., and Col. A. B. Andrews of the Southern Railway.

FINDLAY, OHIO.—The Findlay & North Baltimore Railway Company has been incorporated by James P. Bope, Charles F. Smith, Ed. V. Bope, Wm. Norris and Nat V. Nemeyer. Capital stock, $150,000. The company will build an extension of the Findlay Street Railway to North Baltimore.

CIRCLEVILLE, OHIO.—The Circleville Council has agreed to grant a franchise through the village to the Columbus & Southern Railway Company providing the company will agree to locate its car barns and power house within the village limits. The company objects to this stipulation.

TRENTON, N. J.—It is reported here that the Johnsons, of Cleveland, are at the head of a syndicate which has purchased the right of way for a trolley road from New York to Philadelphia. The syndicate, it is stated, holds the key to the entire system necessary for a through line between the two cities.

DAYTON, OHIO.—The Dayton & Northwestern Traction Company has asked for the franchise grant of the Richmond & Eastern Traction Company which was rescinded a few days ago by the commissioners of Wayne County, Ind. If the grant is secured the road will be extended from Eaton to Richmond, Ind.

NEWTON, MASS.—The Newton Board of Aldermen has granted the Boston & Worcester Street Railway a Newton location. The provisions of the franchise

require that the company first file a bond for $100,000 and the widening of the street for a distance of three and one-half miles at the expense of the road.

TWO RIVERS, WIS.—The inter-urban electric railway between Manitowoc and Two Rivers, for the construction of which a franchise has been granted to Thomas Higgins, of Neenah, will be extended northward to Mishicott, provided a franchise can be obtained, thence to other towns beyond, and probably to Green Bay.

ALBANY, N. Y.—The Yonkers & White Plains Railroad Company has been incorporated with a capital stock of $50,000. The directors are Freeman H. Merrett and W. Jay Wilson of White Plains, R. J. Bellew, B. B. Riley, H. D. Lent, W. J. Fisher, H. C. Merrett and J. E. Lattimer of Tuckahoe, and Charles Husenberry of Yonkers.

CINCINNATI, OHIO.—The Cincinnati Traction Company, an outgrowth of the Consolidated Street Railroad Company of Cincinnati, is preparing to experiment with compressed air for motive power. A central power station is to be built which can afterward be used for an air station. The main station will generate alternating current.

COLUMBUS, OHIO.—The Columbus, Findlay & Toledo Electric Power, Fuel, Light & Railway Company, of La Rue, has been incorporated by A. J. Jones, J. H. Leonard, R. W. McWay, J. D. Miller, G. W. Kemp, M. J. Gootschalk and A. M. Harth. Temporary capital stock, $10,000. The company proposes to build an electric railway from Columbus to Toledo.

MINNEAPOLIS, MINN.—The Twin City Rapid Transit Company is experimenting with a new illuminated car sign. The sign has the names of the different car lines printed on a strip of cloth which is moved in front of a row of incandescent lights. The rollers upon which the sign is wound are turned until the name wanted comes before the lights.

TOLEDO, OHIO.—Stockholders of the Ohio Northern Railroad Company have perfected the organization with the following officers: W. H. Cummer, president; G. W. Kurtz, vice-president and general manager; J. W. Cable, secretary and auditor; A. C. Van Driesen, treasurer. The road will extend from Alverton to Toledo, and much of the right of way has been secured.

LANCASTER, PA.—A consolidation of the Conestoga Traction Company, the Lancaster Railway Company, the Lancaster Gas, Light & Fuel Company and the Edison Electric Light Company has been practically effected. The aggregate capital represents over $50,000,000. The company controlling the combined plants will be incorporated under the name of the Lancaster County Light & Power Company.

CINCINNATI, OHIO.—General Manager C. E. Hooven, of the Cincinnati, Lawrenceburg & Aurora Electric Railway Company is canvassing the villages of Delhi, Home City, Cleves, Fernbank and North Bend with a view to securing franchises for electric lighting. If the franchises can be secured, an independent lighting company will be formed and the present railway power house at North Bend will be enlarged to furnish all the towns with the required number of lights.

CINCINNATI, OHIO.—An electric road is projected from Harrison, Ohio, through Brookville, Ind., completing the interurban line from Cincinnati to Indianapolis, a total distance of 120 miles. With the completion of the Miami Valley Inter-urban Electric Railway Company, which operates a road from Troy to Piqua and a new branch to Minster to connect with the Western Ohio electric road now being built from Lima, there will be a complete line from Cincinnati to Detroit, Mich.

ASHTABULA, OHIO.—At the annual meeting of the stockholders of the Pennsylvania & Ohio Electric Railway Company, held a few days ago, it was voted to increase the capital stock from $100,000 to $600,000. New officers were elected, as follows: Thomas Fricker, president; W. F. Stanley, vice-president; B. W. Baldwin, treasurer; Thomas McGovern, secretary. Material has been received for the extension of the road from Conneaut to Ashtabula, and construction work will start March 1.

NEW INDUSTRIAL COMPANIES.

THE AUTO-DYNAMO CAR COMPANY of New York has been incorporated to manufacture electrical machinery; capital, $200,000.

THE CURTISS CONSTRUCTION COMPANY, Cleveland, Ohio, has been incorporated with a capital stock of $10,000. It will make a specialty of equipping electric and steam railways.

ALBANY, N. Y.—The Adams Construction Company of Buffalo has been incorporated to manufacture electrical equipments; capital, $5,000. Directors: H. S. Wasson, J. O. Munroe and W. J. Jamison, Buffalo.

THE MILLER LIGHTNING CONDUCTOR & MANUFACTURING COMPANY, of St. Louis, has been incorporated; capital stock, $10,000. Incorporated by August F. Miller, George A. Miller and Louis E. Miller.

THE H. E. LINDSEY ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., capitalized at $5,000, has filed articles of incorporation. The incorporators are H. E. Lindsey, James F. Coyle, P. E. Chapman, D. W. Oviatt and James F. Coyle.

THE MERCANTILE ELECTRIC COMPANY of St. Louis, Mo., capitalized at $50,000, as a branch house of the Western Electric Company of Chicago, has leased a building in the Cupples Block, Spruce Street. The building has five stories and basement.

THE ELKHART ELECTRIC COMPANY of Goshen, Ind., has been incorporated; capital stock, $100,000. The incorporators are Martin V. Berger, Charles H. Tenney, J. S. Dodge, Charles Hewitt and James Dushane. The company will purchase the Home Electric Company and expend a large sum on improvements.

OBITUARY.

MAYO G. SMITH.—Dr. Mayo G. Smith died at Colorado Springs, Colo., last week at the age of 85. He was born in Newburyport, Mass., and was one of the first graduates of Oberlin College. He started life as a preacher, but later turned to journalism, becoming a reporter on the New York *Tribune* under Horace Greeley, whose friend he was. Dr. Smith went to California in 1849 and was part owner of the first ship that sailed from San Francisco to Australia. He became wealthy. Dr. Smith was the author of two works on ether and chloroform and was, it is said, associated with Morse in constructing the first telegraph line between Washington and Baltimore.

PERSONAL.

MR. T. A. EDISON left for the South on Feb. 24 on a long projected holiday, and expects to rest until April 1 if he does not get tired of resting before then.

MR. RICHARD CROKER, of Tammany, has bought a water power at Letcombe, his English estate, and is to use it for electric lighting purposes at the Moat House.

MR. H. WARD LEONARD has gone into the automobile field and is bringing out a very handsome gasoline three-passenger motor car, based on the latest French designs.

MR. W. C. MITCHELL, of Manchester, England, the manager of the British Westinghouse Company, has been in Cincinnati meeting bidders on new equipment and purchasing a number of machines for the English branch.

MR. H. S. SUMMERHAYES informs us that he and Mr. B. Heinrich are starting in business as electrical engineers at 625 Howard Street, San Francisco, under the style of the Pacific Electric Company, with himself as secretary of the company, and his associate as president.

MR. ALEX. DOW, general manager, etc., of the Edison Electric Illuminating Company of Detroit, has been a visitor in the East, attending the meeting of the executive committee of the Association of Edison Companies. About $250,000 was spent last year in Detroit on Edison improvements.

MR. HENRY GORDON STOTT, head engineer of the Buffalo General Electric Company, has been appointed superintendent of motive power of the Manhattan Railway Company. Mr. Stott is a Scotchman who has been for some years in this country, doing excellent professional work, especially in handling Niagara power.

MR. CHARLES W. WASON, who is closely identified with Henry Everett in numerous telephone and street railway enterprises in Cleveland and vicinity, was married on Feb. 12 to Miss Breckenridge, of Hamilton, Ont. Mr. and Mrs. Wason sailed a few days ago on a European wedding trip of three month's duration.

MR. PAULDING F. SELLERS has been appointed electrical engineer of the Buffalo General Electric Company. He is a graduate of the Pennsylvania State University, and has been latterly with the Cataract Power & Conduit Company, but now returns to the other concern, for which he was engaged on cable and conduit work some three years ago.

MR. GEORGE BULLOCK, president of the Bullock Electric Manufacturing Company, Cincinnati, Ohio, has taken a personal interest in the development of the water power resources of the South, and on a recent trip of manufacturers and capitalists through that section for the purpose of investigating conditions, received some valuable orders for power equipment.

MR. W. M. MALLETTE, for 13 years manager of the Bell Telephone Company at Rochester, N. Y., and for 10 years previous manager for the Western Union Telegraph Company at Syracuse, N. Y., tried to end his life last week by cutting his throat. The attempt was made in New York City. Prospects of recovery are slight. Mr. Mallette's mind had become affected by business affairs, it is said.

MR. LEVI TEAL, who for a number of years has been associated with the S. S. White Dental Manufacturing Company, of Philadelphia, Pa., was married on Feb. 26, 1901, to Miss Annie E. Haas. This journal joins with their many other friends in congratulations and best wishes for a very happy future. Upon returning from their wedding trip through the South Mr. and Mrs. Teal will reside at 2109 North Twelfth Street, Philadelphia.

MR. H. H. VREELAND, president of the New York Metropolitan Street Railway Company, addressing a large audience last week at a church in this city, remarked that "there are no elevators in the house of success." Every man had to do his own climbing. Mr. Vreeland made reference to the club now maintained by the Metropolitan Company, and gave some hints to conductors and motormen. He said that the company was carefully watching the men who attended the club and used the books in the library, and these men would obtain preference in promotions.

Trade Notes.

THE MACOMBER & WHYTE ROPE COMPANY, Chicago, has increased its capital stock from $2,500 to $60,000.

OIL FILTERS IN ITALY.—The Burt Manufacturing Company, Akron, Ohio, has recently shipped an oil filter to the Société Secula Tramways Omnibus, Palermo, Italy.

FACTORY EQUIPMENT.—Messrs. Keelyn & Smith, Milwaukee, Wis., have the contract for the power and lighting plant for the new factory of the A. Y. Lindemann-Hoverson Company. The contract includes generators, motors, switchboard and construction work.

THE YURGAE SIGNALPHONE MANUFACTURING COMPANY, Milwaukee, Wis., has secured the contract for a 20-station telephone exchange for the Wisconsin Central Railroad Company, to be installed in the new shops at Fond du Lac, Wis. The Yurgae Company has received various other contracts for telephone work in that city and has a full line of instruments and apparatus.

THE LEA-HOOVEN ARC LIGHT & ELECTRIC COMPANY and the Anderson Tool Company, of Indianapolis, Ind., have consolidated. The capital stock will be increased and the plant enlarged.

MR. G. CURT KASTNER has opened offices at 149 East Fourteenth Street, New York. He is prepared to do all kinds of repairing, wiring, etc., and is making a specialty of electrical effects and decorations.

THE CAHILL & HALL ELEVATOR WORKS recently moved into the new three-story building, 133-135 Beale Street, San Francisco, where they have increased facilities for manufacturing electric and hydraulic elevators.

THE PAN-AMERICAN EXPOSITION has issued a new and most tasteful booklet in green cover with a reduction of the beautiful Niagara poster attached. It is full of cuts and information about the great coming show.

CONSUMERS' CARBON COMPANY.—The plant of the Consumers' Carbon Company at Lancaster, Ohio, is being equipped with new machinery, and a portion of it has commenced operation. Within the next two weeks all departments will be in operation and 100 men will be employed.

HEATING AND VENTILATION OF A ROUND HOUSE.—The B. F. Sturtevant Company has published a pamphlet giving extracts from the proceedings of the Central Railway Club relating to the construction of round houses. It is of special interest to railway men.

JOHN SCOTT MEDAL.—The Acme Machine Screw Company, Hartford, Conn., informs us that the committee on science and arts of the Franklin Institute, Philadelphia, has awarded it the John Scott legacy premium and medal for its automatic multiple spindle screw machine.

THE WESTERN ELECTRIC COMPANY, Chicago, is carrying a large stock of lead-covered and braided rubber covered cable; also waterproof cable and wire, from the largest to the smallest commercial sizes. This company is offering these goods at very attractive prices and prompt delivery.

EXTENSION CIRCUIT RINGER.—The Garton-Daniels Company, Keokuk, Ia., is sending out to the trade an eight-page pamphlet illustrating and describing its extension circuit ringer and extension circuit closer, both of which devices were described and illustrated in these columns Feb. 2 last.

MR. EWING McLEAN is manufacturing telephone apparatus at Greencastle, Ind. The McLean plant turns out over 200 complete telephones per month, and its instruments are said to be among the best made. Most of them are used in the country and by the local lines. Mr. McLean fits out exchanges complete.

LUSTRAL.—The H. W. Johns Manufacturing Company is presenting to the trade a line of fine finishes (varnish) known as "Lustral" finishes. These goods are manufactured for the finish of interiors, exteriors, floors, etc. They possess merits which commend them to the consideration of all who desire a superior finish in woodwork.

THE D. M. STEWARD MANUFACTURING COMPANY, Chattanooga, Tenn., will send a copy of its 1901 calendar to any one on application. The calendar possesses the merit of being clear and distinct, large figures being used. The card on which it is mounted shows Uncle Sam on the aggressive with reference to Steward's lava burners and tips.

THE "WOOD" TYPE-A OIL TRANSFORMER manufactured by the Fort Wayne Electric Works, Fort Wayne, Ind., is described and illustrated in Bulletin No. 1013, recently issued by the company. The illustrations used are very clear and show the parts of the transformer and the transformer complete. There are numerous diagrams besides.

SPRAGUE APPARATUS.—The Guger Lithographing Company, Milwaukee, Wis., has contracted for Sprague machinery for operating its presses. The Sprague Company has the contract for a 60-kw generator and press motor outfits of the direct connected and belted type. The contract for the switchboard and construction work has been secured by Mr. Geo. F. Rohn. The Guger Company contemplates operating its entire plant electrically.

COLUMBIA LAMP CALENDAR.—Central stations, isolated plants, etc., are receiving from the Columbia Incandescent Lamp Company, of St. Louis, Mo., an attractive calendar for the first four months of 1901. It shows illustrations of the various styles of lamps made by the company. In the reference to this calendar recently the types gave the company a slightly changed name, but the real name was obvious, as it is too well known to be so easily obscured.

THE VAN DORN-ELLIOTT ELECTRICAL COMPANY, of Cleveland, Ohio, has been incorporated by J. H. Van Dorn, W. H. Elliott, H. H. Hodell, F. Schneider and W. A. Dutton. Capital stock, $50,000. The company takes over the electrical repair and manufacturing business of the Van Dorn & Dutton Company and W. H. Elliott. The gear cutting business of Van Dorn & Dutton will be continued as heretofore. J. H. Van Dorn will be president of the new company.

LIST OF STEEL AND IRON PRODUCTS.—The American Steel & Wire Company has issued in pamphlet form a list of products. This list is comprehensive in detail only to the extent necessary to give a clear idea of what the company makes. Many of the products cannot be briefly listed, but the pamphlet shows enough to indicate the general lines. The list includes all iron and steel manufactures, electrical wires and cables, rail bonds, springs, etc. The pamphlet contains 26 pages.

DR. TOSHI SUZUKI, mining geologist of the Government Imperial Steel Works, Japan, was a recent and interested visitor to the International Correspondence Schools. Dr. Suzuki is an educated Japanese gentleman, who has been visiting in the interests of the mining department of the Imperial Steel Works, at Tokio, several European countries and the United States. He returns to Japan with a fund of valuable practical information, which will be used in the development and working of the mines under his control.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, reports an exceptionally good month, particularly in the line of orders for small machines. Some late contracts include an order for one 75-kw direct connected generator for the town of Versailles, Ohio; a 50-kw direct connected generator for the plant at Perham, Minn.; a 125-kw belted generator, together with several small motors, for the Jamestown Electric Light Company, Jamestown, N. D.; a 100-kw belted generator for the plant at Devils Lake, N. D., and a large direct connected generator for a new hotel at Sioux City, Ia.

THE NATIONAL AUTOMATIC TELEPHONE COMPANY, 153 West Jackson Boulevard, Chicago, Ill., has sold a great many of its party line telephones throughout the States of Kansas and Kentucky. Business in its party line instruments is very flattering. The company believes that this particular system is one of the most easily introduced of any of the telephone systems which have been put on the market, because of the readiness with which it has been accepted, and the reception which it has received would seem to prove that its belief is well founded. One outfit has been shipped within the past few days to the city of Weston, Mo.

MECHANICAL DRAFT.—A unique mechanical draft arrangement consisting of two fans was recently installed at the works of the Diamond Rubber Company, Akron, Ohio, by the B. F. Sturtevant Company of Boston, Mass. Of its operation the owners write that, "with the forced draft at one end and the induced draft at the other, we are enabled to produce a terrific draft and can make steam very rapidly indeed. We have been able to produce a pressure of 1.7 oz. by the forced draft fan and maintain a 2-in. water column at the extremity of our underground breeching or at the inlet of the fan. The construction of the fans is neat, strong and workman like, and the engines run cool and practically noiseless. Taking all into consideration, we are very well pleased."

McROY CONDUITS.—Fifteen million feet of underground conduit is a record that the McRoy Clay Works may well be proud of. In a very handsomely gotten up catalogue for 1901, just issued, the McRoy Clay Works give a very interesting account of their products and the method of installing the same, some very artistic illustrations scattered throughout the catalogue showing the process. The illustrations are half-tone, the views of the conduits themselves being of a buff color to represent the actual color of the same. The catalogue has a very handsome cover on which are embossed representations of Tanagra, and it is certainly one of the most artistic of recent productions in this line. The McRoy Clay Works are in Brazil, Ind., and office at 302 Broadway, New York.

MESSRS. LOWE & LEVERIDGE, 183 Greenwich Street, New York, are handling two very serviceable devices in the L. & L. ceiling switch and the L. & L. showcase lighting fixture. The ceiling switch is operated by a pendant. It has a positive action, and when the blades are once started they cannot be stopped until they reach the limit of action. Alternate pulls on the pendant open and close the switch. This switch is made for 15 amperes, at 250 volts, and has been approved by the National Board of Fire Underwriters. The showcase lighting fixture is so designed that it throws all the light down upon the contents of the case and none into the eyes of the observer. It is attached to the top of the showcase inside. It is a very handy device and is stated to be meeting with a very large sale.

BELT TYPE MACHINES.—The Crocker-Wheeler Company, Ampere, N. J., is introducing a new line of machines, to be known as form F. They are of the multipolar, direct-current belt type, and are intended for service in situations where power must be furnished continuously, and where work must be done in a reliable and satisfactory manner. These machines are at present being built in sizes giving 3, 5 and 7½ horse-power at low speeds, and 4, 6 and 9½ horse-power at moderate speeds. In Bulletin No. 10, just issued by the Crocker-Wheeler Company, these machines are described and illustrated. The illustrations show the application of these motors to the driving of printing presses, milling machines, a vertical pump and an embossing press. Tables and diagrams of dimensions are also included in the bulletin.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, has moved its Eastern sales office to new and larger quarters at 136 Liberty Street, New York. With this additional room a full and complete line of samples can be shown, and each size, finish and voltage of the "Standard" ceiling, desk and bracket fan motors made by this company will be on exhibition. The company will also show a neat little plant, consisting of a motor operating a dynamo, switchboard with various instruments, bank of lamps, etc., for the purpose of demonstrating the high efficiency of its motors and dynamos. The Robbins & Myers Company makes a specialty of small machines from 1-16 horse-power to 10 horse-power in motors, and ¼ kilowatt to 10 kilowatts in dynamos. It reports a large volume of business from the Eastern district, Mr. Wm. B. Van de Water being in charge of this branch of its business.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED FEB. 19, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

668,151. TROLLEY SWITCH; M. D. Baron, New York, N. Y. App. filed May 15, 1899. Levers arranged near the junction are struck by the trolley wheel to throw a connecting conductor section into line with the conductor over which the trolley is traveling.

668,170. ELECTRIC RAILWAY SYSTEM; E. W. Farnham, Chicago, Ill. App. filed Oct. 17, 1900. The working sections traversed by the contact shoe are hung on parallel levers, so as to be depressed by the shoe to make the connection with fixed contacts; springs return the sections to their normal position.

668,194. ROTARY MAGNET FIELD FOR ELECTRICAL MACHINES; Benjamin G. Lamme, Pittsburg. App. filed July 14, 1900. A form of construction of a rotating field magnet for alternating current generators, and adapted for rotation at high speed.

668,213. ATTACHMENT PLUG; W. T. Pringle, Lansdowne, Pa. App. filed Dec. 18, 1899. Details of construction for connecting the contact clip with the body of the insulating plug.

668,215. GALVANIC BATTERY ELECTRODE; C. J. Reed, Philadelphia, Pa. App. filed Sept. 14, 1897. The method of forming battery electrodes which consists in applying to the surface of a conducting body a coating of insulating wax or cement and subsequently forcing finely divided granular carbon into said coating and into contact with the conducting body.

668,233. BRAKE FOR ELECTRIC RAILWAY CARS; E. W. Stull, Johnstown, Pa. App. filed Dec. 12, 1899. When the motors are thrown together in a short closed circuit, to act as generators, a small motor is included in said circuit, which winds up the mechanical brake and sets the shoes against the wheels.

668,235. RHEOSTAT; N. H. Suren, Needham, Mass. App. filed June 29, 1899. Details.

668,246. ELECTRIC LIGHTING APPARATUS; A. J. Wurts, Pittsburg, Pa. App. filed Aug. 19, 1899. (See Current News and Notes.)

668,248. AUTOMATIC COPYING TELEGRAPH; I. Zabinski, Milwaukee, Wis. App. filed Dec. 18, 1899. Certain details whereby the tube or spurter of a syphon recorder is rendered operative or inoperative in connection with the bobbin thereof, to trace the message.

668,257. ELECTROMAGNET; G. L. Foote, Brooklyn, N. Y. App. filed Oct. 19, 1900. Means for adjusting the position of the armature without changing the position or stroke of the vibratory bar used on sounders and relays.

668,260. ELECTRICAL MEASURING INSTRUMENT; K. Lehner, Frankfort-on-the-Main, Germany. App. filed Feb. 16, 1899. Two wires through one of which the current flows, act differentially by their tension to move the index. The flow of current through the one wire heats and expands it, which disturbs the balance and moves the index.

668,282. AMALGAMATOR; C. G. Collins, Woodmere, N. Y. App. filed Jan. 4, 1899. Details.

668,283. AMALGAMATION OF ORES; C. G. Collins, Woodmere, N. Y. App. filed Jan. 13, 1900. Details.

668,284. SEPARATOR FOR BATTERIES; L. W. Collins, Chicago, Ill. App. filed July 7, 1899. The separator consists of V-shaped strips with the apex against one plate and the base edges against the other.

668,293. FUSE BOX; J. F. Lyons, Bridgeport, Conn. App. filed April 17, 1900. The destruction of one fuse releases a lever which will carry a second fuse into position to re-establish the circuit.

668,295. STORAGE BATTERY PLATE; H. M. N. Muhle, Dayton, Ohio. App. filed Oct. 22, 1900. A plurality of battery plates are united by strips of such shape that they can be bent to give the plates a parallel position and the strips then used as the connecting plugs between them.

668,296. TROLLEY SWITCH; E. J. Parker, Worcester, Mass. App. filed Nov. 16, 1899. A block fixed at the junction and containing grooves through which the wheel runs.

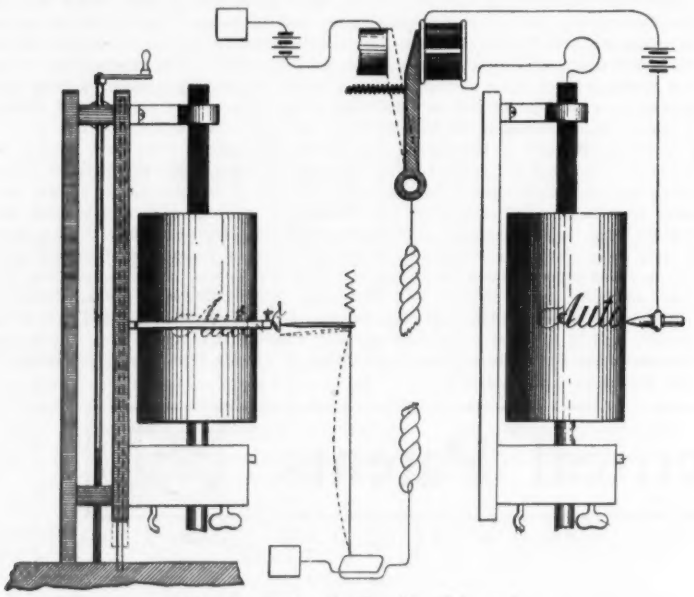
668,300. INSULATING SUPPORT FOR ELECTRICAL CONDUCTORS; H. E. Waite, San Francisco, Cal. App. filed Nov. 16, 1900. The conductor is fastened to a plug of hard rubber which is embedded and supported by a socket of insulating material, which prevents the plug from becoming distorted by the heat.

668,315. RECEIVER FOR ELECTRICAL OSCILLATIONS; G. Marconi, London, Eng. App. filed July 17, 1900. (See Current News and Notes.)

668,345. ELECTRIC ARC LAMP; T. F. Barrett, Chicago, Ill. App. filed Oct. 15, 1900. Details.

668,356. ELECTRICAL ACCUMULATOR BATTERY; P. E. Placet, Paris, France. App. filed Nov. 14, 1899. The plate is composed of a support of fibrous material coated with a protective substance surrounded by conducting coils and incased with a composition of glycerine and oxide of lead.

668,359. ELECTRIC BATTERY CONTACT; A. L. Stevens, New York, N. Y. App. filed July 26, 1900. Electric battery terminal and motor lead-contacts, connecting a vehicle battery and motor in circuit and accessible from outside the vehicle body.



668,248.—Automatic Copying Telegraph.

668,389. ELECTRIC SWITCH; W. F. Richards, Buffalo, N. Y. App. filed Nov. 23, 1899. Details.

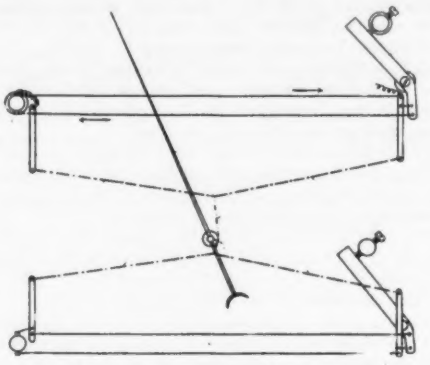
668,419. MACHINE FOR INSULATING OVERHEAD WIRES; O. Russell, Sycamore, Ill. App. filed Aug. 21, 1900. A box adapted to contain insulating material in liquid state and suitable trucks and wipers by which the material can be applied to wires after they are strung.

668,426. TESTING APPARATUS FOR ELECTRIC CIRCUITS; N. H. Suren, Needham, Mass. App. filed June 24, 1899. An instrument provided with a plug and two jacks by which the current and voltage on a circuit can be obtained at once.

668,429. SYNCHRONIZING SYSTEM FOR ALTERNATING CURRENT GENERATORS; H. W. York, New York, N. Y. App. filed June 16, 1899. This patent and the two which follow it relate to means for and method of automatically or manually varying the steam admission to the driving engines so as to bring their generators into synchronism. The specific means used to control the engine is a block adapted to slide along a crank arm on the valve shaft of the engine. The position of the block which determines the stroke of the crank is altered by a small motor mounted upon the arm and rotating a screw in one direction or the other.

668,430. SYNCHRONIZING APPARATUS FOR ALTERNATING CURRENT GENERATORS; H. W. York, New York, N. Y. App. filed May 11, 1900. See the preceding brief.

668,431. METHOD OF SYNCHRONIZING ALTERNATING CURRENT



668,260.—Electrical Measuring Instrument.

GENERATORS; H. W. York, New York, N. Y. App. filed May 11, 1900. See No. 668,429.

668,438. ELEVATOR SIGNAL SYSTEM; M. H. Cullom, Denver, Colo. App. filed April 9, 1900. Details.

668,442. RESISTANCE COIL; A. C. Eastwood, Cleveland, Ohio. App. filed Dec. 13, 1900. A resistance coil wound on a tubular insulator, a conductor being connected to one end of the coil and extending through the tube so as to bring the two terminals of the coil at the same end thereof.

668,453. TROLLEY HEAD; H. A. Nettleton, Manchester, Conn. App. filed Dec. 20, 1900. The axle of the trolley wheel is set in open slots and held in place by latches.

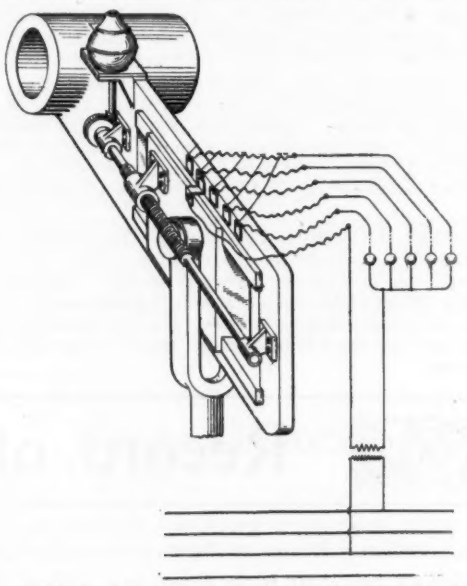
668,472. HOLDER FOR TELEPHONE RECEIVERS; H. M. York, Kennebunk, Maine. App. filed April 30, 1900. Details.

668,517. STORAGE BATTERY PLATE; J. Hewitt, Chicago, Ill. App. filed June 12, 1900. Detail construction of the grid.

668,538. TROLLEY WHEEL; C. R. McAdoo, Indiana, Pa. App. filed Dec. 1, 1900. A detent lying across the top of a wheel to hold the wire in place, but removable when the pole is lowered.

668,554. ELECTRICAL RELAY AND CIRCUIT; A. M. Bullard, Somerville, and L. A. Falk, Boston, Mass. App. filed Dec. 3, 1900. (See Current News and Notes.)

668,555. RESISTANCE COIL; F. Comminge, Pittsburg, Pa. App. filed Dec.



668,431.—Method of Synchronizing Alternating-Current Generators.

11, 1900. The wire of the coil is wound successively over layers of asbestos or other insulating material.

668,581. TROLLEY WHEEL AND BEARING; O. B. Marton, Akron, Ohio. App. filed July 30, 1900. Details.

668,613. AIR BRAKE; Niels A. Christensen, Milwaukee, Wis. App. filed June 12, 1899. Electrical appliances for maintaining the same pressure in the reservoirs throughout the cars of a train.

Supplement to Electrical World and Engineer

MARCH 2, 1901

Berliner Microphone Patent Declared Invalid.

At Boston, on Feb. 27, in the United States Circuit Court, Judge Brown handed down a rescript, giving the gist of a fuller decision to be filed later, declaring the famous Berliner microphone patent invalid.

At Washington, on May 10, 1897, the United States Supreme Court gave out a decision denying the motion of the Government to have the Berliner patent, No. 463,569, of Nov. 17, 1891, set aside on the ground of unnecessary and improper delay in its issuance, it having been filed in 1877, and further because the company had acquiesced and helped in the delay, in order to defraud the public of its rights. The suit originated in the United States Circuit Court for the District of Massachusetts, where it was decided in favor of the United States. Upon appeal to the Circuit Court of Appeals for the First Circuit, this decision was reversed, and the contention of the Berliner claimants upheld. From this opinion the United States appealed to the Supreme Court. The details as to the alleged laches of the Patent Office and the Bell Company are familiar to all acquainted with electrical history. The claims of the patent are as follows:

1. The method of producing in a circuit electrical undulations similar in form to sound-waves by causing the sound-waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact and therefore increase and diminish the resistance of the circuit, substantially as described.

2. An electric speaking-telephone transmitter operated by sound-waves and consisting of a plate sensitive to said sound-waves, electrodes in constant contact with each other and forming part of a circuit which includes a battery or other source of electric energy, and adapted to increase or decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movement of said sensitive plate.

3. The combination, with the diaphragm and vibratory electrode, of a rigidly-held opposing electrode in constant contact with the vibratory electrode, substantially as described.

4. In a telephone transmitter, a vibrational plate made concave for condensing the sound, substantially as set forth.

5. In a telephone transmitter, a vibrational plate provided with one or more apertures, as and for the purposes set forth.

6. A speaking-telephone transmitter comprising a diaphragm or disk sensitive to sound-waves, combined with a rigidly-held but adjustable electrode in contact with the same, whereby the electric current is transformed into a series of undulations corresponding with the vibrations of said diaphragm.

The present decision was handed down Wednesday in the cases of the American Bell Telephone Company against the National Telephone Manufacturing Company and the Century Telephone Company. The actions were tried together. They were brought with a view to having the defendants enjoined from making use of or selling telephones whose validity was involved, related. Appeal from Judge Brown's decision lies, if taken, to the United States Circuit Court of Appeals and not to the Supreme Court.

The Court's decision, which is given below, was read from the bench in the presence of counsel and several others who were interested in the case.

The Court holds that the patent is invalid for want of invention and patentability, and because it was anticipated by Edison and Bell. The proceedings have been dismissed and a decree ordered entered for the defendants.

The substance of the decision follows:

The decree in these cases must be for the defendants. I find the Berliner patent invalid.

Because, at the date of the application, June 4, 1877, Berliner had not made the invention covered by the patent issued to the American Bell Telephone Company on Nov. 17, 1891. It is conclusive that Berliner had not invented and did not intend to apply for a patent for a constant-contact speech transmitter. I find as a matter of fact that Berliner did not before June 4, 1877, succeed in transmitting speech; but, on the contrary, was convinced by his experiments that speech could not be transmitted by the apparatus of the patent in suit. I find also that he did not at that date intend to describe or claim the apparatus as a speech transmitter. In view of the original application the complainant's case cannot be established without proof of successful experiments by Berliner. The invention set forth in the patent lay in experiment. In inventions of this class, the true date of conception is the date at which the experiment succeeds. The complainant concedes that Berliner did not make new apparatus, but reproduced substantially the old Reis apparatus. Proofs that the Reis apparatus or Berliner apparatus, or the Morse key, is operative in the hands of experts does not establish invention by Berliner. He is not entitled as an inventor of apparatus to claim whatever may be found to be within its capacity, because his sole claim to invention is based upon an alleged discovery of a new capacity in old apparatus. If he did not discover this, nothing new remains that he did discover or invent. He did not "embody" an invention in apparatus unless he succeeded in making the old apparatus perform Bell's process upon the current.

Berliner's caveat of April 14, 1877, does not establish invention and does not count as a reduction to practice. It proves a project. Later caveats, the application, the record in the patent office and other evidence show the failure and abandonment of this project. If it is obvious to Berliner or to persons skilled in the art, upon a reading of Bell's patent, that the Reis apparatus could perform Bell's process, then the case fails as to invention. The complainant's case as to invention must rest upon the ground that what was stated in the caveat was not obviously and necessarily true; that experimental verification was necessary, and that Berliner did verify his project by successful experiment, resulting in discovery of facts before unknown. The proof is strong to the contrary.

The second ground of the decision is that the invention described in the patent is radically different from the invention described in the application. The Court says: A comparison of the two documents leaves no doubt on this question. The application expressly disclaims speech transmission by the instrument of the patent; and claims as a speech transmitter a double-pin instrument, operating to make and break contact of electrodes. The patent calls for constant contact of electrodes and an unbroken current; the application for an interrupted contact and a broken current. The original application by changes purporting to be amendments has been completely trans-

formed into an application for a distinct invention. This transformation is of the most remarkable character and was made after Edison's carbon constant-contact speech transmitter was invented and described in a printed publication. Such amendments would be illegal, even if Berliner had made the invention before June 4, 1877.

The amendments made prior to 1880 cannot support the patent as they did not introduce constant contact of electrodes. If they did, they are illegal as introducing a different invention. At the time of the rewritten specification of 1880, the invention had then been in use for more than two years; *i. e.*, since June, 1878.

The third ground of the decision is to the effect that the invention was previously patented by Berliner. Berliner in 1880 took out a patent which covered the speech transmitter of the patent in suit, applied to its appropriate use in a "system"; *i. e.*, with a receiver. The effect of claim four of the 1880 patent was to give a monopoly of this instrument applied to its appropriate use without additional invention in making this application. By granting the patent of 1880, the commissioner exhausted his power to issue a second patent whereby the patentee could control all use of this instrument as a transmitter. Having been protected for 17 years in the use of this transmitter with one receiver, Berliner was not entitled to further protection for use with any and all receivers.

The fourth ground is that Edison was the prior inventor. Aug. 8, 1887, is the earliest date of Berliner's amendment affecting this controversy. Berliner's amended application is anticipated by Edison's application of July 20, 1877, and by the Philadelphia *Press* article of July 9, 1877. The burden of proof is upon the complainants to anticipate Edison. They cannot sustain it. Assuming Berliner's application as of June 4, 1877, he is anticipated by Edison's application of April 20, 1877.

The claims which cover all forms of variable-contact transmitters are embraced in the Bell patent, as well as in Bell's liquid transmitter and in various devices of Edison's. The patent discloses nothing presentable as an art, method or mode of operation.

The method is "by causing the sound waves to vary the pressure," so as to strengthen and weaken the contact. "Causing" is accomplished by placing the apparatus where there are sound waves. This is not patentable as an art or method. Producing sound waves is no part of the method whereby existing sound waves are caused to vary. The patent covers no art or skill acquired in keeping the electrodes in constant contact.

If Berliner made a discovery it was simply a discovery that such minute variations of contact as could be produced between metallic electrodes would transmit speech to a limited extent. If Berliner or others have succeeded in finding that metallic electrodes can be balanced so delicately that they will transmit speech, this is not a discovery that is embodied in the defendant's transmitters.

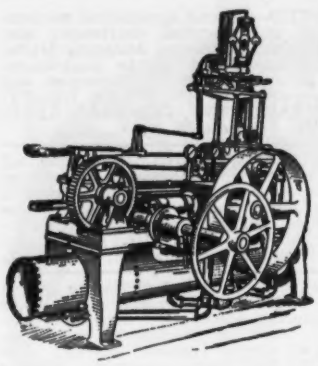
The attempt to expand Berliner's unsuccessful experiments and caveat first into an invention, and next into a broad claim for an art, method, principle or process, exhibits a remarkable degree of ingenuity, but is not convincing.

The Court concludes: "I am of the opinion that the defendant's transmitters are an invention substantially distinct from that disclosed in the Berliner patent; that the conception by Edison of the use of carbon for speech transmission preceded Berliner's conception of the use of solid metallic electrodes; that from his first conception Edison diligently proceeded upon a line of experiments that led to an invention of remarkable character which borrows nothing from Berliner, has no substantial resemblance to what is shown in the Berliner patent and cannot be identified with it by any ingenious use of language. The defendants owe nothing to Berliner.

"The bill is dismissed."

Under the depressing influence of this decision American Telephone & Telegraph stock, quoted on the Boston Stock Exchange, went off from 162 to 157, but was not particularly weak, and gave early signs of rallying, on the ground that the "independents" would no longer be able to work the public on the score of "sympathy" and "monopoly," but must stand up to a square fight. On the other hand, "It is a great victory," said Judge James M. Thomas, president of the Independent Telephone Association, when in New York City on Wednesday night. "Capital that has been withheld from the telephone business will undoubtedly be put in it now by men who were afraid of the outcome of this suit. The Bell Company's stock may hold up for a time, but this is bound to affect it eventually. It will be beneficial to the public generally, in that it will encourage independent telephone enterprise. Here in New York the Knickerbocker Company and in Boston the Massachusetts Company will be encouraged to go ahead. The Court sustains every defense we set up. We had six chances to win, and we won on all six. That is certainly a decisive victory."

President Z. S. Holbrook, of the Massachusetts Telephone & Telegraph Company, which has lately completed an independent exchange in Boston, says: "The Berliner decision, while it affects the validity of the patent which the Bell people desired to have extended, nevertheless was dependent upon one telephone of a certain construction. The decision now opens up telephony to the world. The decision should have no effect upon the company's standing and the break in the shares is of sentimental effect. In fact, I have recently offered a reward of $500 to any one who would construct a telephone on the Berliner patent and make it work."



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2	600 "	G. E., A30, toothed armature, compound wound.
2	650 "	T.-H., A35, self-oilers, composite wound.
1	750 "	Wood, compound, self-oiler.
2	750 "	Westinghouse, s. o., 37½ K.W.
1	900 "	Warren, 45 K.W., inductor type.
1	1000 "	Wood, 50 K.W., toothed armt.
1	1000 "	Siemens & Halske, 50 K.W., 60 cycle, single-phase, inductor type.
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1	1200 "	Siemens & Halske, 60 K.W., 60 cycle, single phase.
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1	12 "	Edison, self-oiler.
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1	20 "	Sprague, compound, s. o.
1	20 "	American Engine Co.
1	40 "	Eddy, M.P.
1	45 "	Edison, compound, self-oiler.
1	60 "	Siemens & Halske, M.P., s. o., for direct connection.
1	120 "	Siemens & Halske, M.P., s. o., for direct connection.

500-VOLT GENERATORS.

1	15 K.W.	T.-H., self-oiler.
1	25 "	T.-H., self-oiler.
1	25 "	General Electric, M.P.
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1	3 "	Crocker-Wheeler, s. o., s. s.
2	3 "	Card, slow speed, self-oilers.
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1	5 "	C & C.
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1	25 "	T-H.
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1	7½ "	Siemens & Halske, M.P.
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1	10 "	Eddy, M.P., self-oiler, s. s.
1	10 "	Westinghouse, M.P., self-oiler.
1	15 "	Siemens & Halske, M.P.
1	15 "	Eddy, self-oiler.
1	18 "	Thomson-Houston, self-oiler.
1	18 "	C & C, self-oiler.
1	20 "	Commercial, self-oiler.
1	20 "	Card, self-oiler.
1	30 "	Commercial, self-oiler.
1	30 "	General Electric, M.P.
1	40 H.P.	Wood, M.P.
2	40 "	Siemens & Halske, M.P.
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1—15-hp Excelsior.
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1—16-kw Lundell.
2—20-kw Edison.
5—25-kw Edison.
3—30-kw Edison.
2—45-kw Edison.
1—45-kw General Electric M.P.
1—50-kw Siemens & Halske.
2—60-kw Edison.
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1—10-hp Eddy.
1—10-hp Thomson-Houston.
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1—6-hp Holtzer-Cabot.
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3—90-kw transformers.

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1—75-kw Stanley, 2000-1000 volts, two-phase, 16,000 alternations.
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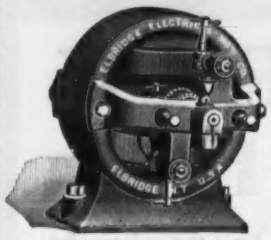

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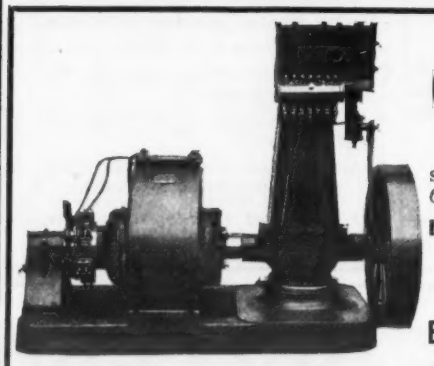

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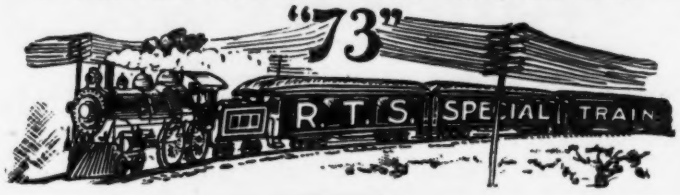

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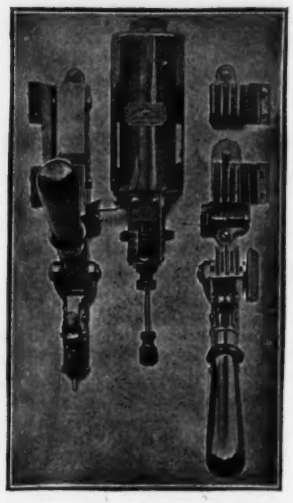

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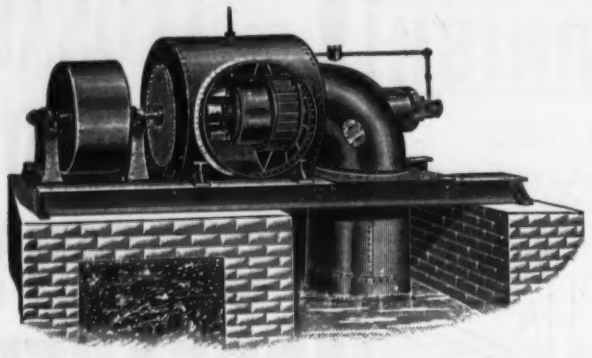

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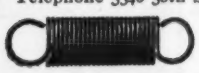

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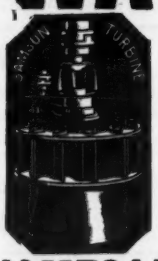

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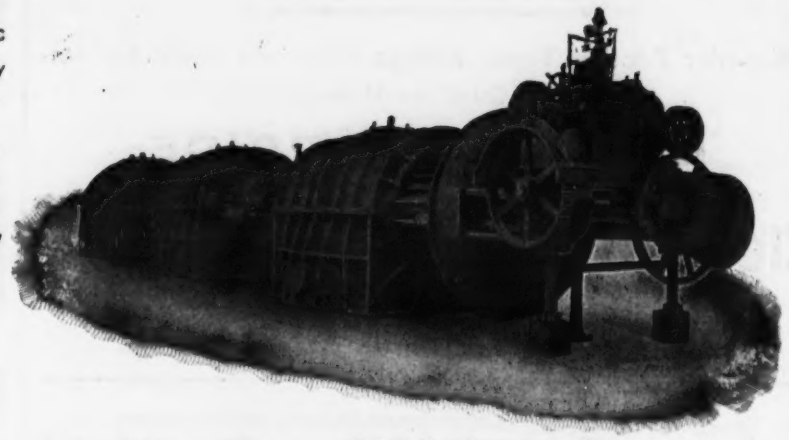

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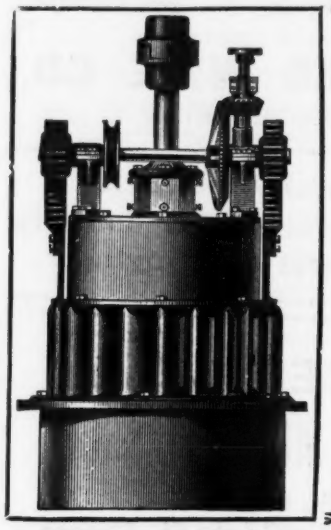

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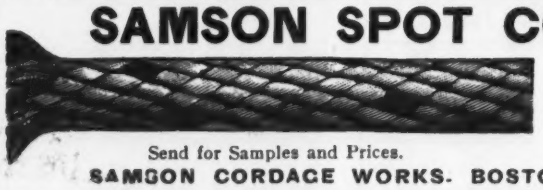

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